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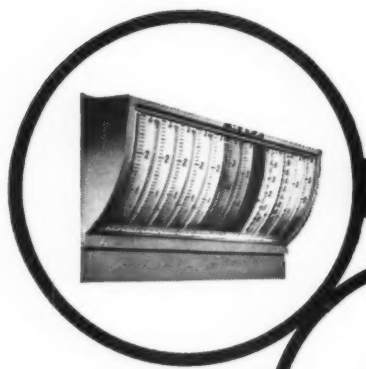


... we would not argue the principles.

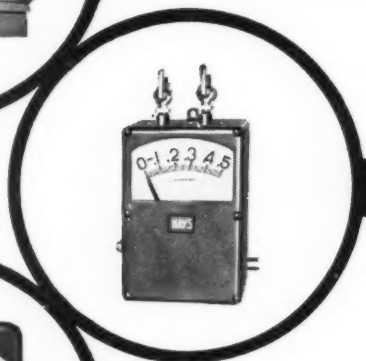
Comment from the Coast

J. SIMON FLUOR heads a \$27 million organization founded in 1912 by his father in Santa Ana, California. The elder Fluor had come to this country from Switzerland, when he was twenty-one, to join his brother in Oshkosh, Wisconsin. They worked together as Fluor Bros. Construction Co., concentrating primarily on the building of paper and lumber mills.

(Continued on page 8)



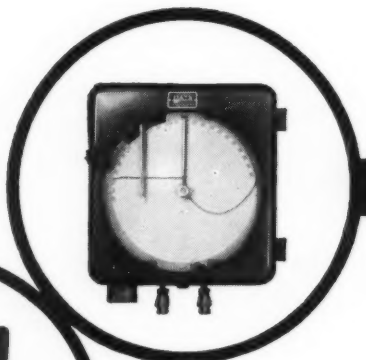
W-Gage for large boilers and remote indication



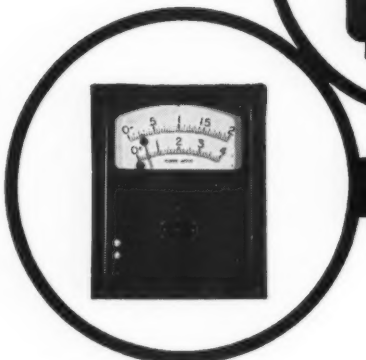
B-Gage for small boilers, combustion testing and air filters



FOT-Gage for furnace pressure or fuel flow - air flow indication



OT-Recorder for draft or pressure



D-Gage for commercial, institutional boilers and industrial furnaces

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Hays gages

will meet your

**LOW
PRESSURE**

requirements

Whether you need a draft gage for the largest steam generator, or a small portable gage for spot checking pressure conditions, first or last, it will pay you to talk to Hays, manufacturer of the most complete line of draft and low pressure gages.

Functional in styling, Hays gages have the features instrument men have always asked for—easy to read, accessible and extremely dependable.

The heart of all Hays low pressure gages is a diaphragm housed in cast metal. Diaphragms are easily replaceable in the field.

All Hays gages are guaranteed to withstand at least 100% over range without failure!

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Combustion Test Sets
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CORPORATION

MICHIGAN CITY 32, INDIANA

VOLUME 4

NUMBER 2

Published by Industry and Power Publications

consulting engineer

AUGUST 1954

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AUGUST 1954

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ARCHITECT:

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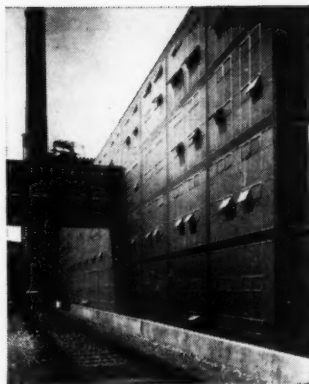
CONTRACTOR:

George A. Fuller Company, New York, N.Y.

ALUMINUM SUBCONTRACTOR:

E. K. Geyser Company, Pittsburgh, Pa.

ALUMINUM ON THE SKYLINE—The story of the Alcoa Building is available in booklet form or as a motion picture for group showings.



CURTAIN WALL

because of light weight,
corrosion resistance,
low cost...

The Heinz Vinegar Building in Pittsburgh has introduced a handsome new application of Alcoa Aluminum for industrial architecture. The walls are of hammered glass with mullions, muntins and projected ventilator sections of Alcoa Aluminum. Aluminum was selected for the wall because of its light weight, particular suitability to industrial atmospheres and relatively low cost.

The aluminum glass wall performs a curtain function only, resisting both the weather from the outside and the highly corrosive fumes from the vinegar vats inside. Since neither fire rating nor interior air conditioning is required, backup and insulation have been omitted. Aluminum glazing members are so designed that glass panels can be easily replaced in the event of breakage.

For complete details on this and other interesting architectural applications of Alcoa Aluminum, call your local Alcoa sales office or warehouse distributor. Complete stocks of standard Alcoa Aluminum Architectural Shapes and Industrial Roofing and Siding are readily available. ALUMINUM COMPANY OF AMERICA, 1891-H Alcoa Building, Pittsburgh 19, Pennsylvania.

ALCOA 
ALUMINUM

ALUMINUM COMPANY OF AMERICA



Comment From The Coast

—Starts on Front Cover

With this background in industrial construction, Fluor, Senior, left for the West Coast — at just the right time. Oil and gas were becoming big business in California, and in 1915, the Fluor Corporation, Ltd. got its first contract from Southern Counties Gas Company. With the discovery of really great oil fields in California in 1920-23, the company landed some major construction contracts, and the general field of the firm's operations was firmly established. While Fluor Corporation has engaged in the engineering, design, and construction of many types of plants, the concentration of effort has always remained in the petroleum, petrochemical and allied industries.

Manufacturing

Fluor Corporation is also engaged in manufacturing — principally special equipment used in petrochemicals — cooling towers, pulsation dampeners, mufflers, and gas cleaners.

The company has extended its operations — partly through wholly owned subsidiaries — into Canada, Latin America, the Middle and Far East, and the Caribbean. This foreign work has grown tremendously since the war, and it now accounts for about 25 percent of the company's gross income.

Here, then, is a large organization engaged not only in engineering but in construction and even manufacturing. Fluor can not only design and handle engineering on a project but can build it — and in the process install some of their own equipment. This is just about the ultimate of the "package" or "turn-key" type of operation — currently a most controversial subject in engineering circles.

A Reason Why

"We recognize the problem," Fluor says, "and if we had gone into some other construction field, we might have been just engineers, just constructors, or perhaps we might have been simply manufacturers. But in the petroleum construction business, we did what it was necessary to do. We started in business and we soon learned how to build a refinery. We found that we could do the best job by hiring our own engineers — men who knew the oil business and could work right along with us until the job was completed.

"Then, in 1921, my father found it necessary to design a cooling tower for a Signal Hill project. It turned out to be a good tower — the best design available for the industry. We built them to meet the

needs of other construction jobs and found ourselves in the business of manufacturing cooling towers. It is merely a question of our having been able and willing to do what was required to build the best possible refineries."

Fluor thoroughly understands the problems involved. "We would not argue the principles," he says. "No doubt there are many projects on which it is wise to have complete separation of engineering and construction functions. But we think we know as much about both the engineering and construction of petroleum plants as any other single organization in the country, and we believe the customers therefore get better jobs for their money. On the other hand, we are willing to do either the engineering or the construction, leaving the other to another firm. We are also willing to just sell the cooling towers or other equipment for another firm's project. However, I think we can prove by past experience that we can handle the whole project from design to operation — with the best final results.

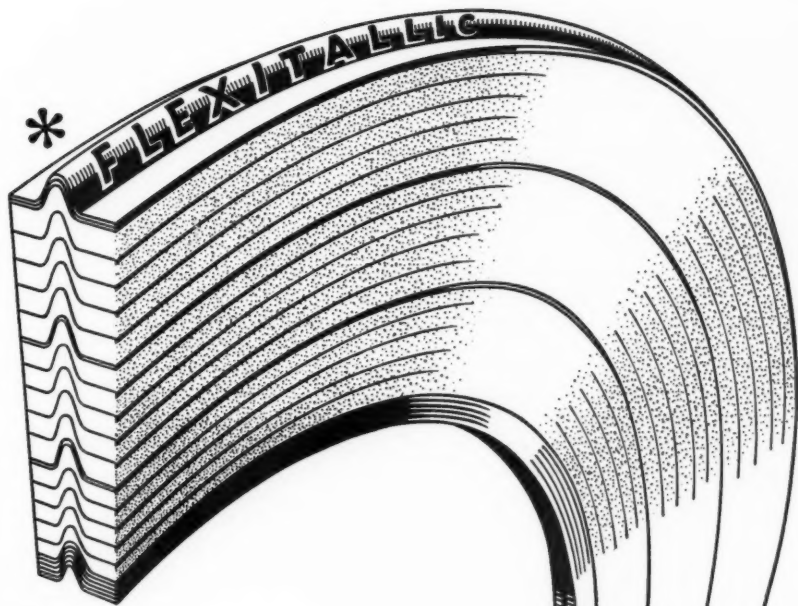
"This cooling tower business can be embarrassing, of course. We always try to include our cooling towers in the original contract so that there is a complete understanding with the customer. We have, but would rather not, bid competitively against other tower manufacturers when we are the engineers and constructors. If somebody beats us — which has happened — that is embarrassing. We prefer to get those points straight with the customer very early in the negotiations.

Foreign Projects

"Having an organization that can offer both engineering and construction has obviously been helpful in building foreign business. I believe that even the strongest proponents of separation of responsibilities agree that the "package" project is practically a necessity in most foreign work in the "backward" countries. We have been successful in construction work in both Latin America and in the Middle and Far East — in work with which we were familiar.

"That brings up a most important point. A lot of American engineers and constructors are expanding their foreign business. I think I can give them some good advice. Stick to the same type of work in which you have specialized in this country. If you have been building power plants here, you can probably build power plants anywhere, but don't take your first paper or textile mill job in some remote land. We build petroleum or petrochemical plants just as well in Timbucktoo as in Texas, but we now know that on foreign jobs we should stick to work we know well — work we have done before.

"It is hard to lose money on a 'cost plus' contract, but it can be done if you are on a strange project in a strange land. We know our field, and know it well, and we know that if we stick to our field we can do a good job and make money doing it." ▲ ▲



BECAUSE THEY DARED TO PIONEER

When Flexitallic Gasket Company pioneered the spiral-wound gasket construction in 1912, American Industry welcomed a new era in the sealing of flanged joints.

The Flexitallic principle — a uniquely resilient construction — made it possible to confine fluids safely at hitherto unheard of pressures and temperatures.

Gasket materials have improved. Application knowledge has increased. But, Flexitallic design engineers are just as insistent today as they were then that each Flexitallic Gasket be exactly right for the job it is supposed to do . . . and keep on doing.

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**TEFLON FOR
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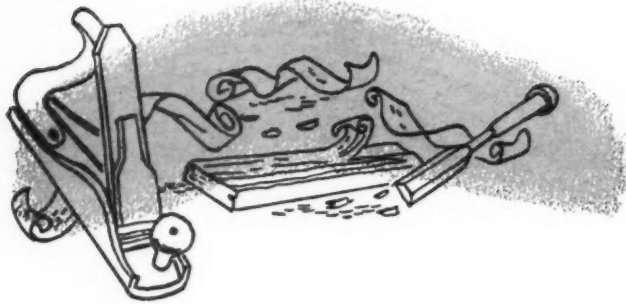
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SCRAPS & SHAVINGS

A YOUNG MAN whose name is L. Stewart McCoy has written an interesting article in the July issue of *Civil Engineering* telling of some trouble he has been having with a labor union. McCoy works for the contracting firm of Terry & Wright, Inc., of Louisville, Ky., who have been building a part of the Ohio Turnpike. He was engaged as a member of one of the engineering field parties.

Last winter, the IUOE (International Union of Operating Engineers), the union to which the construction equipment operators belong, decided to organize all the field parties on the turnpike. McCoy refused to join the union; the union struck; McCoy was moved to another type of work and filed suit against the IUOE for unfair labor practice.

In his article McCoy says that this is a very serious matter, and we agree. He goes on to say that IUOE has an ambitious plan to control all construction and to unionize even the draftsmen and engineers of the consulting firms who design and draw plans for construction projects. We think he might be right again.

McCoy does not like this business at all, and we are still right with him. CONSULTING ENGINEER always has taken a firm stand against unionization of engineers, for we do not believe that professional activity can be blended with collective bargaining.

Later in his article, following his fine stand against the IUOE, McCoy comes forth with a most unfortunate solution to the problem. He suggested that we should organize our own union "based on professional fundamentals." Frankly, we fail to see how a union can be based on professional fundamentals. McCoy does not tell us what "professional fundamentals" are, but presumably they are the same basic concepts of professionalism to be found in the other honored professions. They do not bed well with collective bargaining.

We feel sure that we would object just as strongly to membership in Mr. McCoy's EWPF (Engineers with Professional Fundamentals) as to membership in IUOE. Actually, if McCoy wants to join a union, he does not need to organize one. There is a perfectly respectable union already in existence with a disappointingly high engineering membership. All he need do is to get in touch with the head of his Local ESA (Engineers and Scientists of America). They are a professional collective bargaining group —

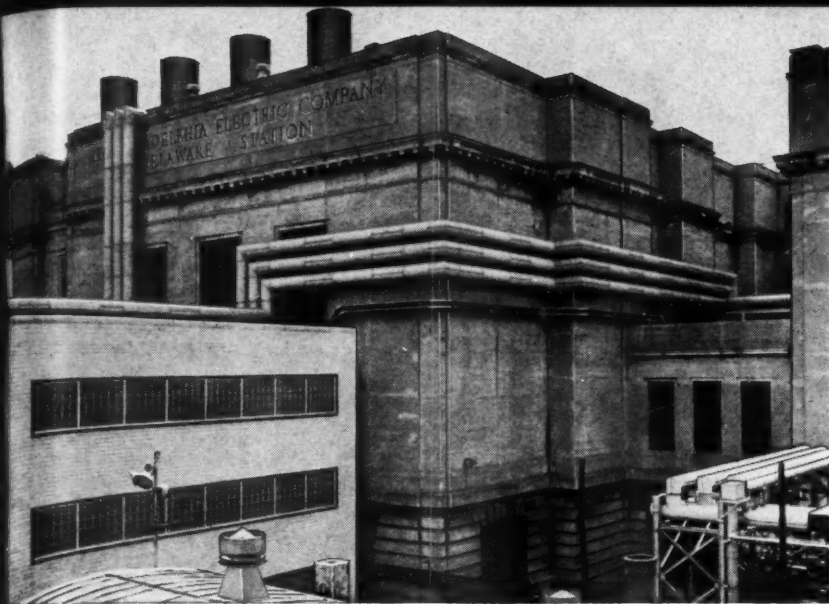
they have even struck — and McCoy says, "I believe a professional group could provide a solution." They should be just the group for him — but they are not for us. We do not believe that ESA or any other "professional union" is the answer to IUOE.

Labor unions serve a very real purpose in the economy of this country. We do not see that a union of professional men would fill any similar need. Whether or not any man needs to be represented in collective bargaining depends upon a number of factors. One of these is the type of work he is doing. Another is the type of work he intends to do. For example, if a young man decides he wants to be a machinist, he serves his apprenticeship and gets a job in a shop. He generally intends to remain a machinist until perhaps he is given some day a supervisory job. He certainly has every right to belong to a union as long as he remains in a non-supervisory job. No one would suggest that during the time he was a machinist he was merely "a supervisor in training" or serving a term as an "intern" before becoming a supervisor.

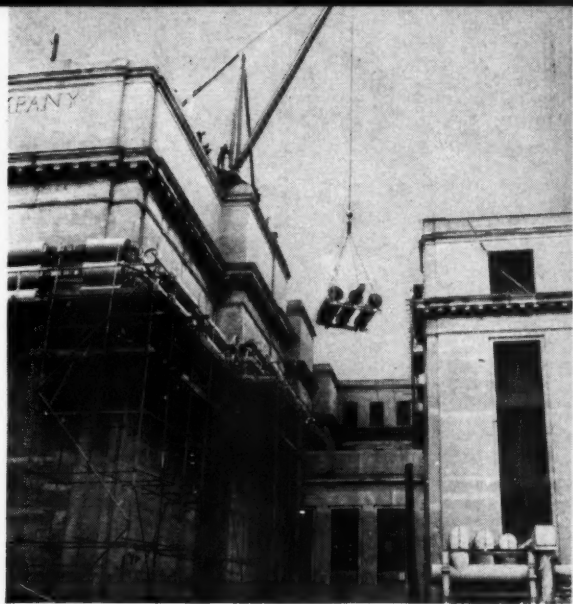
On the other hand, the young man with an engineering degree who is doing field work or drafting is usually considered an "engineer in training" just as the young medical graduate is serving an internship before going into practice. Such a man certainly has little need for a union, and when he moves up the ladder to private practice or to supervisory work in industry, he becomes ineligible for membership.

The engineer (or perhaps we should say technician) who could use the services of a union is the one who never gets out of the "engineer in training" stage — the man who remains a rodman or a draftsman for many years. Despite a degree, such a man should not be called an engineer. He is the equivalent of a medical graduate who never completed his internship — a sub-professional employee. If such a man wants to join a union to gain the advantages of collective bargaining, we can see no objection. But he would not need a professional union. He should be satisfied to join the IUOE where he would be in the company of other non-professional technical employees.

The professional engineer is another sort of man. He needs no union. He is able to bargain for himself. He has in his make-up an independence of thought, a spirit that needs no part of collective activity. ▲ ▲



COMPLETED INSTALLATION showing Isolated Phase Bus running along outside walls and over the roofs. Sections are designed for long, straight runs—or to fit small, cramped quarters—for both inside and outside installation.



DURING INSTALLATION prefabricated sections were delivered to site completely assembled . . . ready to fit in place.

All power generated at *Delaware Station* now feeds through Isolated Phase Bus

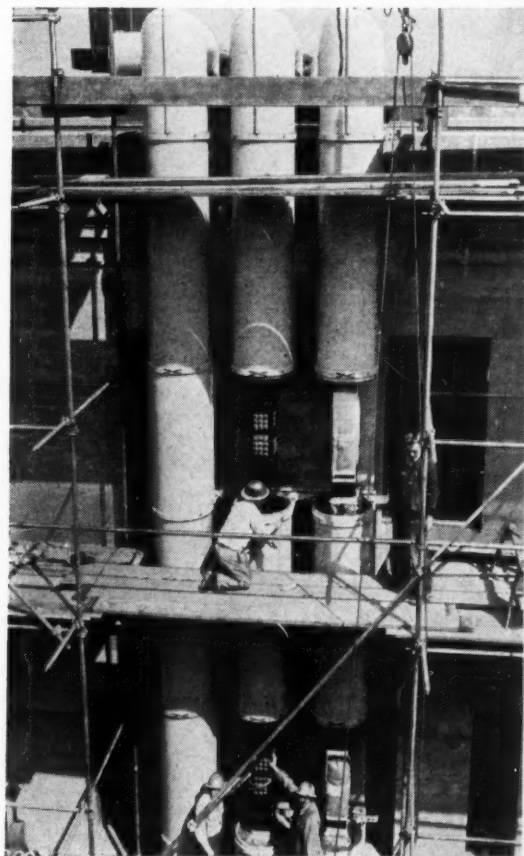
Throughout the station are more than 8700 single-phase feet of I-T-E Isolated Phase Bus. The installation includes long, straight outdoor runs utilizing large assembled units—and short lengths in cramped indoor locations where small pieces are necessary.

In planning the modernization and expansion of Delaware Station, Philadelphia Electric Company engineers decided on the use of I-T-E Isolated Phase Bus because of the following advantages:

- Construction is sturdy and compact**
- Phase-to-phase faults are eliminated**
- Ground bus can carry a phase-to-ground fault**
- Porcelain is used to best advantage (in compression only)**
- High degree of safety afforded to operating personnel**
- Ease and flexibility of installation cut costs**
- Minimum maintenance is required**

From the start, I-T-E Application Engineers worked in close cooperation with Philadelphia Electric Company engineers. I-T-E prepared comparative estimates, and suggested ways to utilize basic assemblies—thus minimizing investment and delivery time. Factory-matched and -assembled lengths, easily adaptable to both the old and new construction, were delivered *on time*, ready for installation.

For details contact the I-T-E Field Office nearest you. Look in your classified directory under "Electric Equipment."



FACTORY-MATCHED SECTIONS are erected to follow building contours. Conductor connections are made. Alternate welded covers and minimum gasketing assure a tight assembly . . . save erection time.



I-T-E CIRCUIT BREAKER COMPANY

19TH AND HAMILTON STREETS, PHILADELPHIA 30, PA.

ISOLATED PHASE BUS



READERS' COMMENT

Favors Unity Through N.S.P.E.
Sir:

I have read with great interest your "Scrap & Shavings" article on the Engineers Joint Council. There are many more qualified than I am to discuss this, but I will try my best. The National Society of Professional Engineers has tried to get on a co-operative or united front with EJC, but have always run up against the things mentioned in your article. NSPE is a member organization. It is run by the individual members in the local chapters. The chapters thru their state directors tell the state organization what it can and cannot do, and the same applies to NSPE

thru the state directors to the National Group. It is truly a grass roots organization.

The second problem confronting NSPE is the fact that it is composed of Professional Engineers who are licensed by the different states. The term Professional Engineer cannot be used legally unless you are certified by the state. As you know, many of the Founder Societies do not require registration as a basis of membership. There are many members who could not obtain registration.

I am biased, as most individuals, but feel that NSPE an existing organization is the answer you are

looking for. It is a member group open to all Professional Engineers and is run by the members. It is not in conflict with the technical societies, but has as its sole purpose the uniting of the Engineering Profession to better the welfare of Engineers.

NSPE was founded in 1934 by five states that had registration. It was not until 1947 that one-half of the states had this requirement. Now about forty-four states are included. NSPE has 35,000 members and is growing fast.

Let's all join NSPE and we will have the 200,000 members you speak of all in a truly Democratic Engineering Society.

G. S. Stiles
Fresno, California

Atomic Techniques
Sir:

In the third paragraph on page 19 of your July issue, under the heading "Atoms in Action," there is reference to a technique that has been developed for the detection of minute leaks. There is also a reference to a gamma-ray detection device that senses changes in gas or fluid densities.

We would appreciate it very much if you could let us know where we can secure further information on these items.

John E. Keleher
Douglas M. McBean, Inc.
Consulting Engineers
East Rochester, New York

• FOR FURTHER INFORMATION ON LEAKS: ROY QUINN, BABCOCK & WILCOX, 161 E 42nd ST., NEW YORK, N.Y. FOR DETAILS OF GAMMA-RAY DEVICE: P. J. STEWART, ISOTOPE PRODUCTS, LTD., OAKVILLE, ONTARIO, CANADA.

No Graver Error
Sir:

We note that on page 70 of the June, 1954 issue of CONSULTING ENGINEER there is a description of the Graver Spirol-Mix Flocculator. However, there is no mention made of the fact that this is one of Graver Water Conditioning Company's newest developments.

We, here at Graver, feel that the Spirol-Mix Flocculator is one of our more important contributions to the water treatment field, in which we have been actively engaged and have contributed many new developments since 1906. The Graver Spirol-Mix is the only unit now available that will produce uniform roll-mix action in the same direction as the flow, provide for a progressive rate of

ATTENTION ENGINEERS!

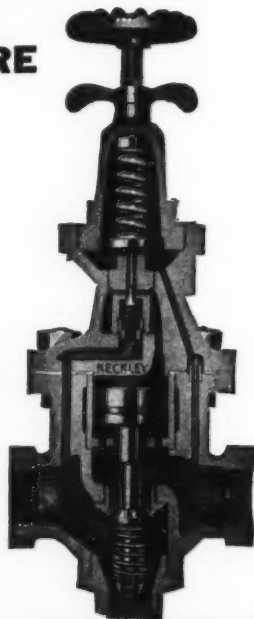
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and durability in **PRESSURE**
and **TEMPERATURE**
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40th Anniversary

agitation as the water rises in the basin and eliminate short-circuiting of flow. These features, besides many others, will make the Graver Spirol-Mix Flocculator a most useful item of equipment in the municipal water treatment field.

R. S. Lewis, Advertising Manager
Graver Water Conditioning Co.
New York 11, New York

Expert Witness

Sir:

We have read with great interest Mr. Beach's article entitled "The Engineer as an Expert Witness" which appeared in the June 1954 issue of CONSULTING ENGINEER. We would like to have a few copies of this article for use by attorneys and technical experts during the course of their preparation for trial.

P. G. Cooper
Domestic Patent Operations Mgr.
Radio Corporation of America
Princeton, New Jersey

Fee Schedules

Sir:

On page 11 of the April 1954 issue of the CONSULTING ENGINEER, the writer of the letter "Union Supporter" mentioned that the American Institute of Consulting Engineers publish fee schedules. Will you please advise me if you have them available, and if not, where I can write to get them.

Glen E. Wimmer
Consulting Engineer

• "SCHEDULE ON FEES" AVAILABLE FOR 25 CENTS FROM AMERICAN INSTITUTE OF CONSULTING ENGINEERS, 33 WEST 39TH ST., NEW YORK 18.

Engineering Organizations

Sir:

Many thanks for your excellent magazine. I enjoy reading it and find it very helpful.

I would be pleased to have you send me the mailing address of the "Association of Consulting Management Engineers, Inc."

Please advise if there is an organization other than the above which is known as Association of Consulting Engineers, or perhaps American Association of Consulting Engineers.

If there are two groups could you send the mailing address of both organizations.

Salvatore S. Guzzardi
Consulting Engineer
Philadelphia 3, Pa.

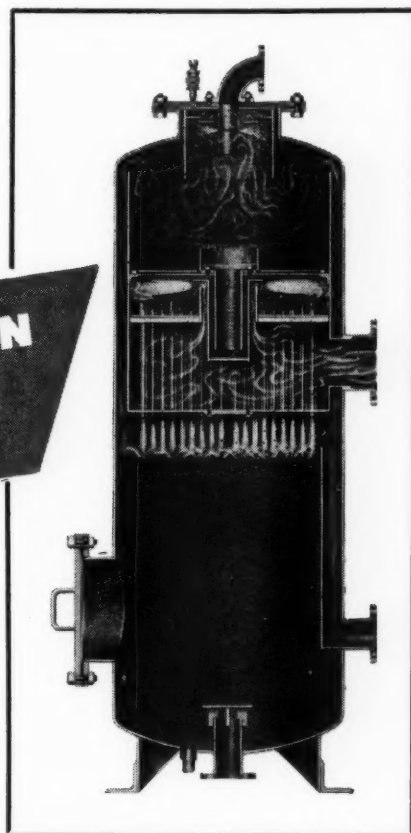
• ASSOCIATION OF CONSULTING MANAGEMENT ENGINEERS IS LOCATED AT 247 MADISON AVE., NEW YORK, N.Y. AMERICAN INSTITUTE OF CONSULTING ENGINEERS IS 33 WEST 39th ST., NEW YORK 18, N.Y.

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the AMERICAN
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DEAERATOR

*Handles the toughest
deaerating problems
with ease!*



American's Jet-Tray Deaerators are the first new conception of the deaerating process in the past ten years! The Jet-Tray Deaerator provides a combination of spray-type, direct contact, first stage heater (where substantial gas removal occurs), a steam jet atomizer and a multiplicity of wetted wall mass exchange towers in a third gas separating section.

American Jet-Tray Deaerators exclusively use the higher pressure of the incoming steam in indirect heat transfer with the tray deaerating process to increase the efficiency of the wetted-wall surfaces. A liquid seal between the first heating and gas removal stage and the later deaeration stages prevents highly contaminated vapors from contacting the water again.

The wetted-wall deaeration section contains more surface area, and provides greater vapor turbulence and water agitation than any tray deaerator made.

The American Jet-Tray Deaerator has the capacity to thoroughly deaerate under the most difficult conditions and establishes an improved standard of performance.

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TO THE INDUSTRY

AMERICAN *Water Softener* **COMPANY**
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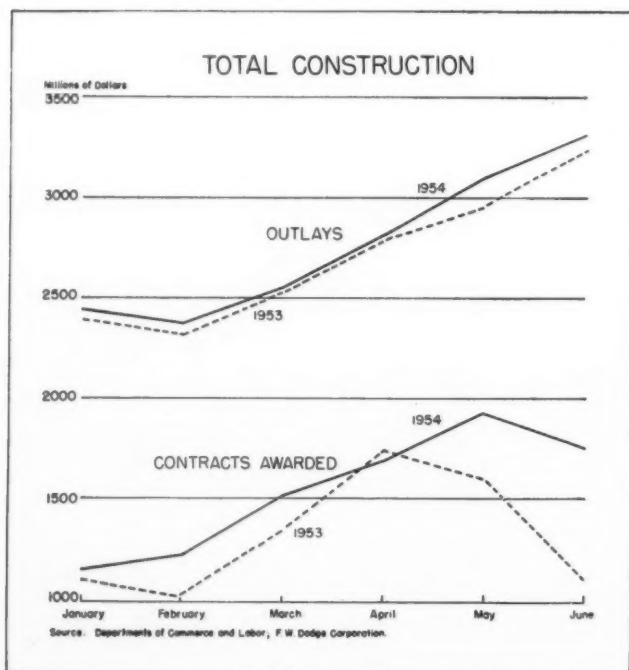
ECONOMIC NEWS NOTES

E. F. Mac Donald
INDUSTRIAL ECONOMIST



◇ **JUST LIKE TOPSY**—Government-owned-and-operated enterprises are getting a long overdue investigation. Activities of the Government have spread into so many fields—managing hotels, roasting coffee, baling scrap metal, building houses—that no one's quite sure how many there are, what lines they're in, or what their costs are. A congressional subcommittee is going to look into the whole Hydra-headed shebang, and the Pentagon has ordered the Armed Forces to conduct cost studies of 31 commercial and industrial activities. The ultimate goal, as spelled out in bill H.R.8832, is that of minimizing Government competition with private business. But at almost the same time that the preceding bill was passed, the Senate voted to authorize the Government to engage in commercial production of atomic energy.

◇ **DEPRESSION THWARTER**—The recession would have been much more severe, perhaps more akin to a depression, had construction activity declined during the past year. Instead, it boomed to all-time record highs. As shown in the chart, outlays (unadjusted) in the first half of this year ran ahead of a year ago by 2.1%. A continued high level of construction outlays appears assured for the rest of the year since contract awards are substantially higher than last year, exceeding the total for the first half of 1953 by 17.5%.



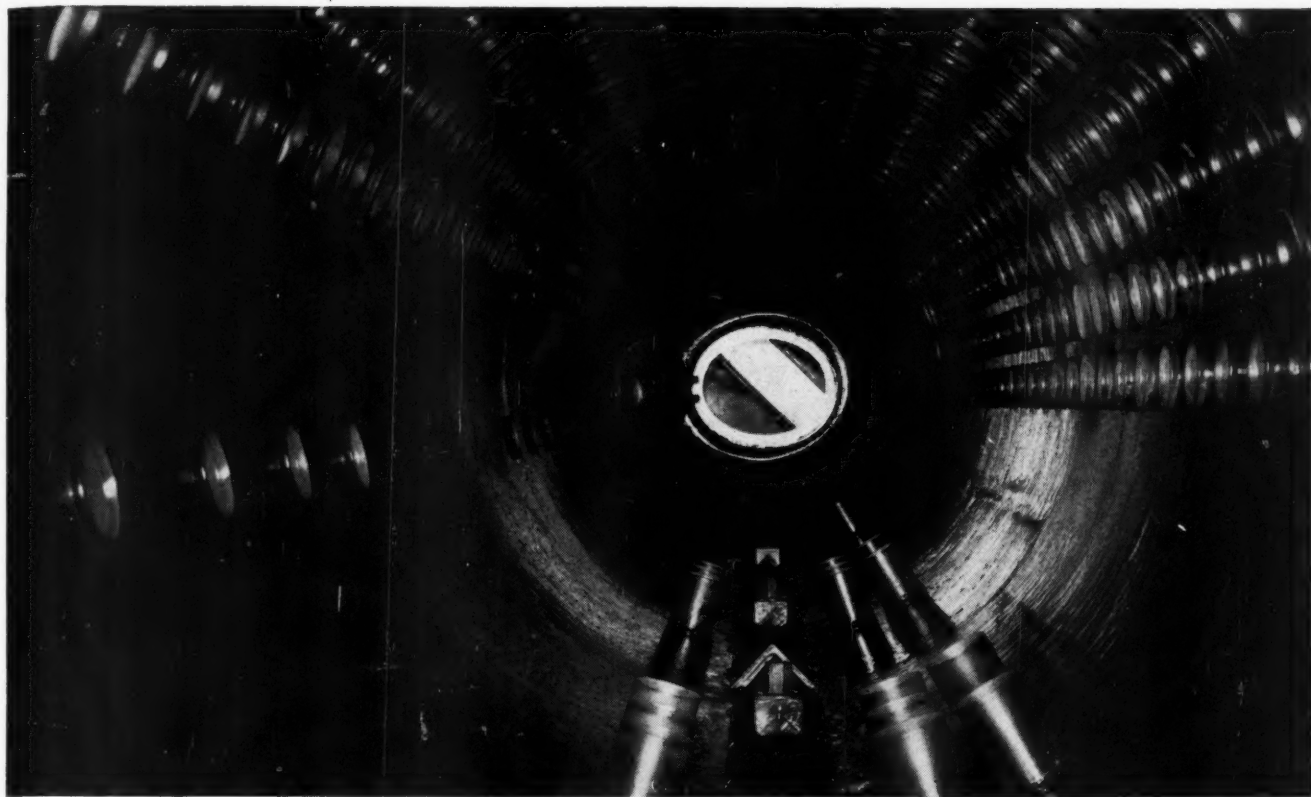
◇ **FOR RENT: MEN**—They've got "For Rent" signs hanging on engineers now. Fischer & Associates and Euclid Industrial Design Corp., engineering firms in Cleveland, will rent engineers by the hour for as long a time as desired and for whatever specific or general projects the "lessee" has in mind. This is strictly a rental deal not to be confused with the more customary situation in which engineering services are hired to do a specific job for a flat fee.

◇ **FOR RENT: MACHINES**—If you have a complicated engineering problem or want to check, say, the design of a new piece of equipment without the cost of building experimental models, you can hire electronic equipment to give you the answer. Electronic Associates, Inc. has opened a center in Princeton, N.J. equipped with analog computers and operators capable of solving some managerial problems such as material procurement and market analysis as well as engineering problems.

◇ **RENT OR BUY**—"The most flexible and complete financing and leasing plan in the field," is Jones & Lamson Machine Co.'s description of its latest sales financing plans. The Vermont machine tool firm, together with CIT Corp., industrial financing organization, has worked out true lease plans, an installment financing plan, and a leasing plan with an option to buy. Pointing out that 60% of the 400,000 lathes in the country are over 10 years old, the company argues that "Industry can no longer afford to operate marginal machine tools when new equipment can be purchased or leased with savings made by its purchase."

◇ **92,900,000 MILES AWAY**—Solar energy has been making news uncommonly frequently lately. We've had reports of Bell Tel's solar battery, Consolidated Vultee's solar furnace, a solar-fired boiler designed by Dr. Abbott of the Smithsonian Institution, and a solar energy installation in Spain. In addition, *Dun's Review* recently ran an article on the subject. Harnessing the tides and the sun's rays have always been fascinating topics and always seemingly on the verge of practical application.

◇ **LOCATION FACTOR**—Still another new factor must now be considered among the many affecting industrial location—automation. So claimed Mr. D. G. Osborn of Kroger Co. in a recent report, "Geographical Features of the Automation of Industry." He cites a number of cases in which automation reduced by one-half the amount of plant area required for each unit of product. Also, to the extent that labor requirements are reduced by automation, "the effect is to free a plant somewhat from the necessity of locating with respect to a labor pool."



Dearborn 659* Sludge Conditioner keeps this boiler clean...eliminates expensive yearly cleaning.

THIS IS WHAT YOU CAN EXPECT WHEN DEARBORN IS IN THE PICTURE

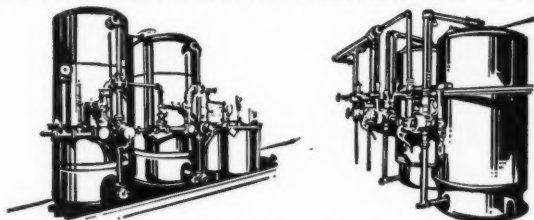
...a clean boiler throughout the year at minimum operating cost. Dearborn provides complete water conditioning and engineering service in one customized program. Tailored to meet the

exact requirements of your systems. Look to Dearborn...the single source for those who take pride in their plant operation.

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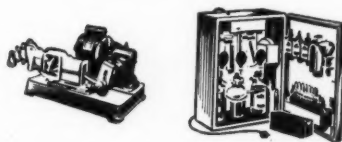
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Dearborn has the knowledge and experience to design and furnish complete ion-exchange equipment, including mono-bed and 2-bed demineralizers, sodium-hydrogen split stream softeners, sodium exchange softeners either alone or in conjunction with hot lime softeners.

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Get plus results with Dearborn engineered water treatment feeding, proportioning and test equipment. Let your Dearborn engineer analyze existing equipment, plan a plant layout, and recommend the system you need.

Know your *Dearborn* engineer

Dearborn has specialized in the conditioning of water and the control of corrosion since 1887. This broad experience in water treatment and rust prevention—plus Dearborn's extensive research and laboratory facilities are at your service. It will pay you to consult with your Dearborn engineer.



Dearborn

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EVERYWHERE SINCE 1887

ATOMS IN ACTION

EXPERIMENTAL BOILING water reactors have been found to remain stable when boiling within the core is permitted. Instead of "running away," the reactor tolerated power excursions without melting the fuel or producing radioactive contamination. This means that boiling reactors can be designed to shut themselves down without serious damage in case of trouble. This points the way to power reactors with inherent safety features wherein the reactor can be used as a direct source of steam without an intermediate heat exchanger. Further investigations will determine whether such a reactor will produce hazardous radiation in the turbines, condenser, feedwater pumps, and other power generation equipment.

BUILDING A BETATRON? Allis-Chalmers has published a colorful booklet showing how a betatron is built. An interesting feature of the pamphlet is the step-by-step series of illustrations showing how the building progresses.

IN FIFTEEN years the number of organizations handling radioisotopes has increased from 25 to 3400; in the same period, from 1939 to 1954, the number of persons involved has increased from 500 to 15,000. Over 860 firms comprising 1100 industrial plants use radioisotopes today; present savings attributed to their use runs around \$100,000,000 per year, and this rate is expected to increase ten-fold in ten years. The applications of radioisotopes to radiographic inspection, thickness gauging, tracing, and wear calibration are comparatively well known. But even dishwashing is now being improved with the help of radioisotopes; the effectiveness of new dishwashing devices is being measured ten times more accurately by the use of radioisotopes than by the use of the best previous technique.

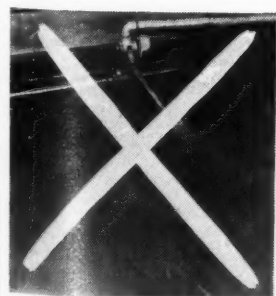
THE WEST COAST now has a library designed to serve as an Atomic Energy Industrial Information Depository. The AEC has announced that the Stanford Research Institute will be the third such location where the AEC will make published information available for general use. The other depositories are the Atomic Industrial Forum, New York, and the John Crerar Library, Chicago.

REACTORS FOR SALE have been announced by Babcock & Wilcox. Two atomic research reactors - a water boiler and a swimming pool type - are offered at firm prices of \$100,000 to \$150,000, each, depending on specifications and installation requirements. For a dollar, another firm is offering a "Geigerscope" which will enable every citizen to do his own detecting of radioactivity; it is about the size of a pen knife. And a new set of scale-model atoms is on the market. It is claimed that they offer the widest variety of structural unit types now available. ▲ ▲



MR. CONSULTING ENGINEER:

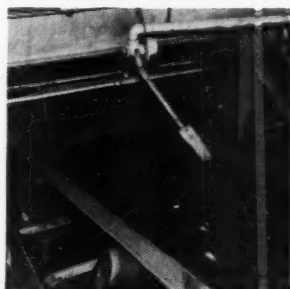
There's a Low-Cost System to **STOP THAT DUST!**



Here's just one example of how Johnson-March stops dust right at its source. The Johnson-March system is turned off at this point where coal is discharged from a chute onto a conveyor belt

in a power plant. Compare this unretouched photo with the one below.

This unretouched photo shows the Johnson-March system operating at the same discharge point. Note absence of dust. These systems are proving themselves in hundreds of plants.



● Controlling dust in the processing and handling of bulk materials such as metal ores, coal, coke, and rock products is a problem that calls for the ingenuity and ability of a mechanical engineer.

The Johnson-March Liquid Dust Control System controls or eliminates dust effectively without cumbersome and costly ducts, hoods and blowers. Dust is stopped *wherever it occurs*, without interfering with your normal operations. Cost of installation and maintenance is much less than other dust control systems.

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Johnson  March
Specialists in Dust Control

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the Range Finder

DR. GERALD J. MATCHETT

Department of Business and Economics

and

Director, National Center of Dynamic Equipment Policy

Illinois Institute of Technology

FASTER WRITEOFFS of capital assets can mean more money in the pocket to practically every business enterprise. The possibility of following such a policy for income tax purposes may be just around the proverbial corner and will be watched for by alert managements and by consultants.

President Eisenhower, in his January budget message, proposed legislation to allow faster depreciation of assets. His proposal was immediately approved by the Ways and Means Committee of the House of Representatives. It has survived where other tax recommendations have been eliminated or modified—it will very likely be incorporated in any tax legislation passed this year.

Present Depreciation Practice

At the present time, most firms follow the practice of straight-line depreciation for tax purposes and for determining costs, profits, and losses during any given year. Straight-line depreciation involves determining the estimated service life of any capital asset; dividing the acquisition cost (less any terminal salvage value) by this service life then gives the uniform annual depreciation amount that the Treasury will allow to be added to other business costs in determining taxable income.

This and certain other depreciation methods pose the problem of estimating the service life of an asset. The Treasury Department and the Bureau of Internal Revenue have taken the position that the prospective useful lives of depreciable assets must be determined as precisely as possible. Furthermore, the burden of proof is placed squarely on the taxpayer for justifying whatever rates of depreciation are claimed. Where the taxpayer has sufficient past records to satisfactorily establish the probable service life of assets, the Treasury ordinarily allows the use of such lives.

In many firms, however, records are frequently insufficient to establish service lives. The Treasury

then requires that the life estimates be consistent with those presented in its official manual (Bulletin F) which is presumed to reflect average experience, or to be consistent with rates allowed other taxpayers in the same line of business, or to reflect some similar criterion. In actual practice the final determination of lives is often the outcome of "horse trading" when the taxpayer's return is subjected to scrutiny by the Treasury. A number of authorities on tax problems and depreciation have come to feel that allowable life estimates have tended to exaggerate the useful life of earning assets and that depreciation allowances have become unrealistic.

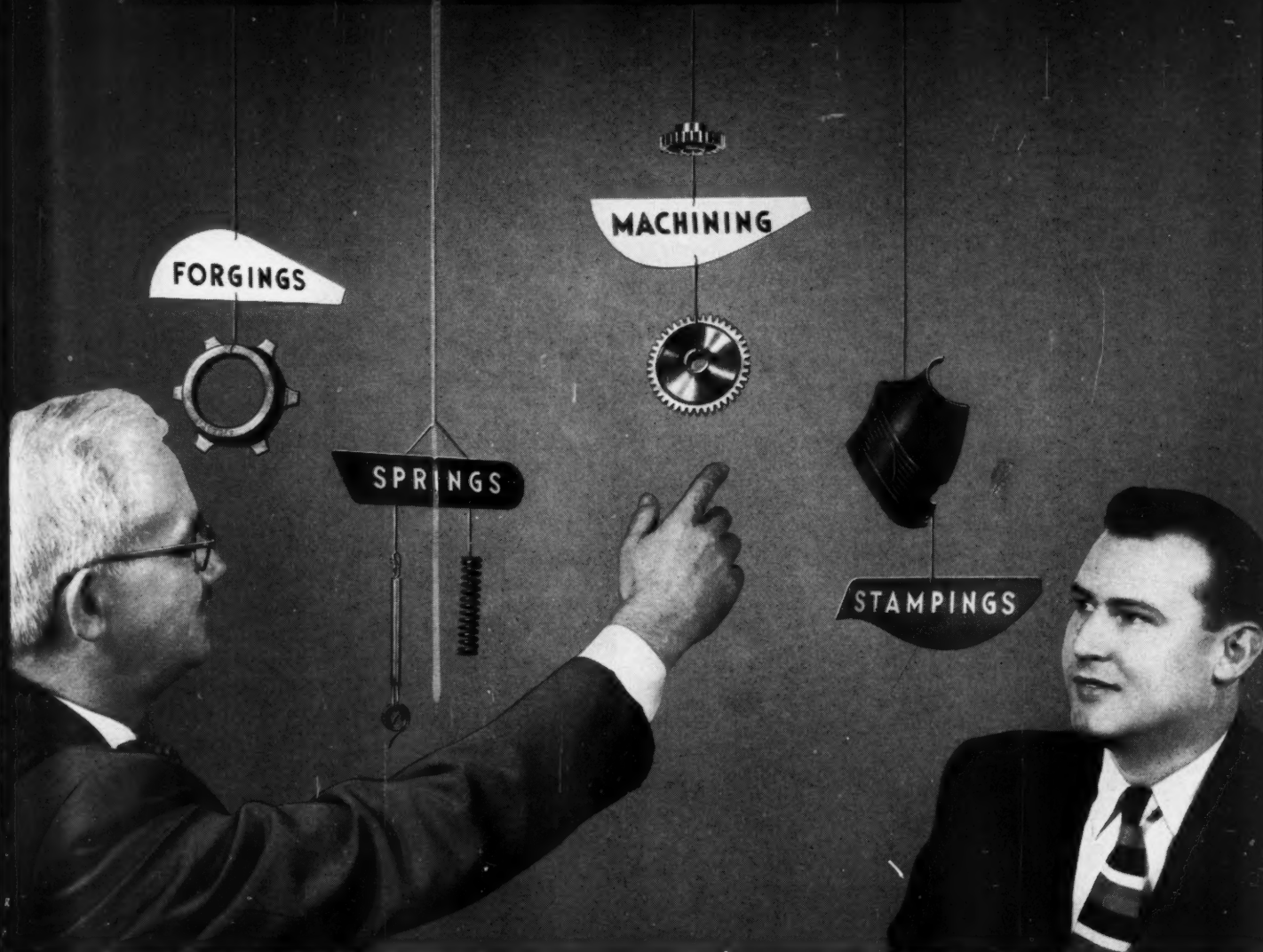
Weaknesses of Straight-Line Depreciation

Even apart from the difficulties of determining an appropriate life to use in computing a depreciation allowance, straight-line depreciation implicitly involves what many experts consider a fatal weakness. This weakness can be demonstrated by a very simple example. Suppose a company purchases an automobile for \$2000 and suppose its life is estimated at five years—at the end of this time it can be sold or traded for \$500. The depreciation allowance would be \$300 per year for a period of five years until the \$1500 is depreciated. The book value would decline by \$300 each year.

Now as everyone knows, the actual value of an automobile does not behave in this manner. The real depreciation or loss in market value is heavy during the early years of life and less during the later years of life. Hence the real market depreciation is understated by the straight-line method during the early years in the life of such an asset and overstated during the later years.

It is true that other types of earning assets may not lose value in the same way that an automobile does, but most studies point to the fact that the decrease in value of most assets is greater during the early years of life than during the later years. Those

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who advocate declining-balance depreciation feel that its faster depreciation in the early years of an asset will inject a greater degree of realism in today's accounting practice.

Declining-Balance Depreciation

The declining-balance method of depreciation in itself is not new. In fact, it is in widespread use in Great Britain and in the British Commonwealth countries. In this country, firms have always been able to use declining-balance depreciation, but rate limitations have been such as to make it less attractive than straight-line depreciation. For example, the Treasury has insisted that the declining-balance rate not exceed 1.5 times the corresponding straight-line rate for a given asset — a restriction sufficient to make it unattractive. The administration's proposal to Congress is that firms be allowed to use the declining-balance method with a rate twice that ap-

propriate to the ordinary straight-line method.

To illustrate the importance of this proposal, take an earning asset that has just been acquired for \$20,000. Further assume that a life of 10 years is acceptable to the Treasury. On a straight-line basis, \$2000 per year is allowable as a depreciation charge, that is, an amount equal to 10 percent of the acquisition cost.

Under the new proposal, a company may use a depreciation rate of twice this amount or 20 percent. This 20 percent, however, is applied to the initial cost of the asset only for the first year. Thereafter, it is applied to the declining book value of the asset. Thus, the depreciation charge the first year would amount to \$4000, leaving a book value or a declining balance of \$16,000.

From this illustration it can be seen that the double-rate, declining-balance method of depreciation provides for a faster write-off than does straight-line depre-

ciation. In fact, the double rate allows about two-thirds of the value of an asset to be written off during the first half of its life.

The declining-balance method does have one defect in that it does not provide for the complete writeoff of an asset over its estimated service life. In the foregoing illustration, the book value at the end of 10 years would be just under \$2150. With the double rate, the undepreciated balance ordinarily will range between 10 and 12 percent of the original cost. Such a balance will usually not be too serious. It will tend to be offset by the terminal salvage value of the asset; in many cases the remaining balance can be charged against income as a disposal loss when the asset is finally retired.

Tax Advantages

A more rapid writeoff does not mean the possibility of a greater writeoff over the life of an asset. Any tax advantage, therefore, must lie in the matter of timing. The general principle involved is simple. The advantage of an earlier receipt of tax deduction rests on the fact that "time is money." More specifically, the funds made available by the earlier tax benefits can be put to work in the taxpayer's business and can earn an immediate return. This return represents an additional gain to the firm even though tax liabilities will be increased later on when depreciation allowances diminish toward the end of the life of an asset. The more pressed a firm is for funds — the more the immediate use of money means to a company — the greater is the tax advantage of a faster depreciation write-off.

The advantage may also be substantial in the case of a growing enterprise. As long as a firm is growing and acquiring more and more assets, it will maintain a favorable balance not offset by the slower depreciation of the assets as they become older.

While the greatest gains from accelerating the depreciation

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writeoff arise from the earlier receipt of the tax benefits involved, the acceleration is advantageous for another reason; it reduces the frequency and importance of those cases in which depreciation is taken without any resulting tax benefit. In order to obtain a tax benefit it is, of course, necessary to have a taxable income. It may happen that toward the end of the life of an asset, income from it may dwindle because it is performing less efficiently. If the undepreciated balance is greater than the salvage value when a unit is retired, this loss is deductible from income provided such income exists.

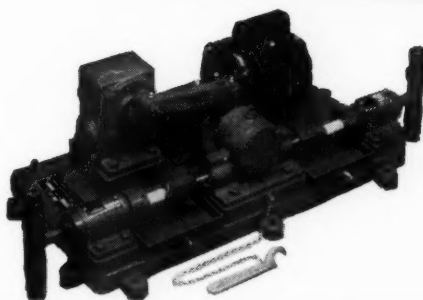
For a taxpayer with a large number and variety of capital assets, the retirement of a partially depreciated unit may involve little risk of not having income from which to deduct the loss. The case is different, however, for a one-asset taxpayer where the consequences of a partially depreciated retirement may be serious. If a taxpayer owns 1000 office buildings, which he depreciates on an assumed average life of 50 years, he can get substantial protection through compensating errors. But, if 1000 taxpayers each own one building, those who happen to draw the short-lived structures are in an exposed position, and many of them will take terminal losses without tax benefit. The more rapid the depreciation, the less is the risk of terminal loss.

Non-Tax Advantages

From the point of view of management and the consultant, the non-tax advantages of a more rapid writeoff may well be of more significance than the tax benefits. Management decisions are necessarily made with an eye to their effect on costs, income, and profits. A correct accounting of cost and income is possible only if the book value of an asset approximates closely its real market value. An accounting policy that understates depreciation overstates profits. ▲ ▲

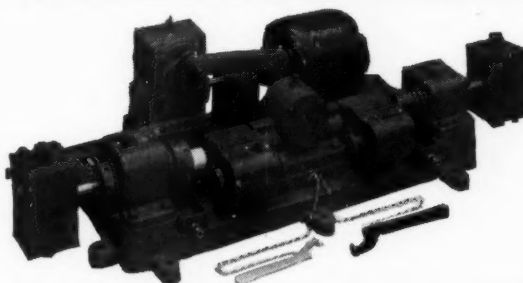
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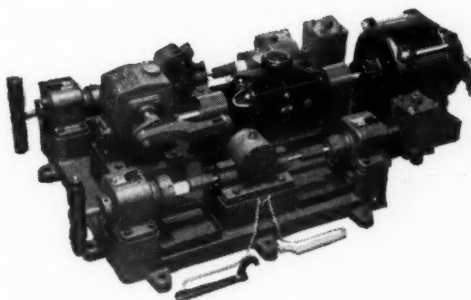
STANDARD 1, 2, 3 or 4 FEED UNITS

Standard "U" Pumps are available in maximum capacities from 0.10 to 24.0 gal. per hr. per feed. Operating pressures from 125 to 5000 psi.



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A CONSTRUCTION CONTRACT involving arbitration was that of the Board of Education v. Town of Islip, 129 N. Y. Supp. (2d) 344, a New York case decided on April 12, 1954. The building contract contained the standard provisions, "The architect shall . . . make decisions on all claims . . . relating to the execution and progress of the work or the interpretation of the contract documents . . . All the Architect's decisions are subject to arbitration."

A dispute arose as to whether certain work constituted an extra, and as to its reasonable value. The owner claims the work was to be performed as part of the contract that was let for a lump sum, and that, therefore, there was no issue to be arbitrated. However, the court dismissed this argument, merely saying "The language of the arbitration provisions of the contract is sufficiently broad to express an intention of the parties to submit a dispute such as (this) to arbitration."

Options and Assignments

An interesting case concerning oil leases and contracts to assign them is Phillips Petroleum Co. v. McCormick, 211 Fed. (2d) 361, a federal case decided on March 13, 1954. McCormick owned a federal oil and gas lease covering 2300 acres of the public domain in New Mexico. He entered into a preliminary contract with the Phillips Petroleum Co. under which he granted Phillips the option to acquire the exclusive right to explore, produce, treat, handle, and market the oil and gas from the leased lands, provided the option was exercised within two years. One of the terms of this preliminary agreement was that Phillips should have the right to surrender to McCormick all of its rights by notifying McCormick, after which the option would be considered terminated.

Later, upon Phillips' request, McCormick assigned his lease to Phillips, the assignment provid-

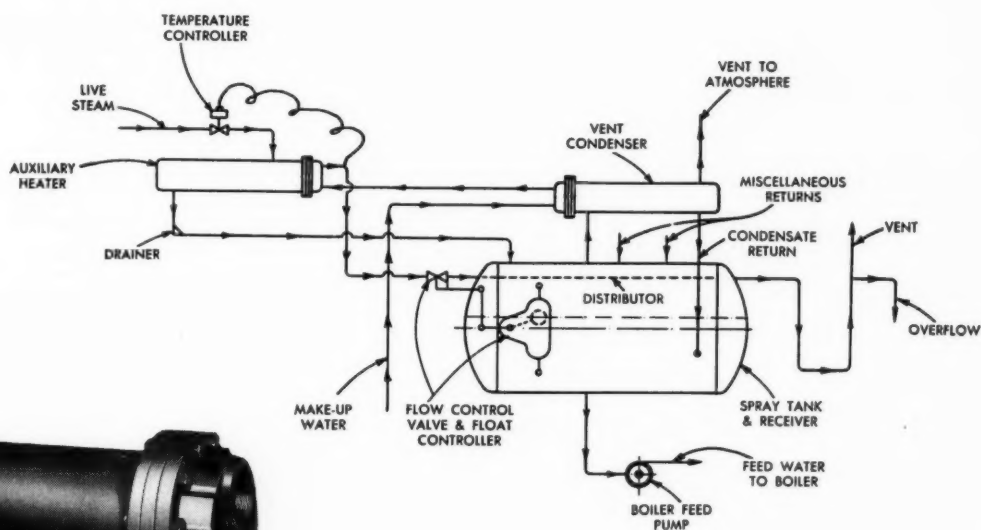
ing 2½-percent overriding royalties to McCormick. The assignment gave Phillips the right "to release, forfeit, and surrender" the lease (without saying to whom), after which Phillips would be relieved of all liability. After spending \$300,000 in exploration, Phillips decided that the lease was unproductive and surrendered it to the federal government without notifying McCormick beforehand. McCormick claims Phillips had no right to do this, as it extinguished his overriding interest.

The court held that the terms of the actual assignment controlled rather than the preliminary agreement. Although the assignment contract did not say to whom the lease could be surrendered, the upper court said it was "obvious" that what was meant was that Phillips could surrender the lease to the federal government, and that since no duty to notify McCormick was mentioned in the contract, it would not be implied. So McCormick was just out of luck. (Incidentally, the lower court thought it was obvious that the assignment contract meant the same as the preliminary contract, i.e. that the lease could be surrendered only to McCormick!)

Machinery Seized

Another well-digging case was Green Machinery Co. v. Green, 266 S.W. (2d) 279, a Texas case decided on Oct. 26, 1953. This one, however, involved drilling for irrigation water. The Green Machinery Co. entered into an oral agreement with M. F. Green to drill an irrigation well for him. After the well was drilled, Green paid the company \$2142 in the mistaken belief that the well had been driven into waterbearing gravel. He claims that that was what the agreement called for. When he discovered that the well had not reached water-bearing gravel, he kept the motor and other equipment sent out by the company, totalling \$1780 in value.

A jury believed Green and awarded him \$362 to make up for the difference between what he had



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CONTROL raw water gases with a Whitlock Spray Type Deaerating Feedwater Heating System — the sure way to maintain safe, non-corrosive boiler feedwater. This system reduces destructive gas inclusions to an accepted maximum of 0.005 cc per liter. It's a simple unitized system, including spray receiver, auxiliary heater, and vent condenser . . . easy to install, economical to operate, low on maintenance.

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The rate at which oxygen is transferred from atmosphere to a solution is, for example, directly proportional to the amount of exposed surface area of that solution, while the corrosion rate of immersed metal is, in turn, proportional to the oxygen concentration of the solution. Therefore, with all other factors stabilized, a reduction in exposed surface area will slow the oxygen-solution process, thereby greatly retarding corrosion.

How deeply metal is immersed, particularly in a quiet solution, is another determinant of corrosive action in which dissolved oxygen is the governing factor. Oxygen satura-

tion, highest at and near the surface, diminishes with increasing depth as convection currents become less active. Corrosion at and immediately below the surface of a liquid is therefore far more severe than that encountered at greater depths.

These and other variables that combine to produce a given corrosion problem must be evaluated in any attempt to reach an effective and practical solution. Such evaluation, based on thirty-five years' corrosion-control experience, is standard Dampney procedure. That is why your specification of a Dampney Coating assures you so much *more* — protection you can depend upon to meet not only standard industrial service requirements but your specific equipment-operating needs. For data on Dampney Protective Coatings and their place in your corrosion-control program, write

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158-1

HYDE PARK, BOSTON 36, MASSACHUSETTS

paid and the machinery he had retained. The company argued that Green had accepted the benefits of the contract by retaining possession of the equipment, but the court refused to go along with this, holding that the company had failed to live up to its agreement and was therefore entitled to nothing on the contract.

Subcontractor's Bond

Anchorage Sand & Gravel Co. v. Alaska Dock & Bridge Builders, 119 Fed. Supp. 943, a federal case decided on April 5, 1954, involved a subcontractor's bond. Max J. Juney was the general contractor and the Alaska Dock & Bridge Builders Inc. was a subcontractor. According to an agreement between them, the subcontractor was required to furnish performance and payment bonds. This was done. The Anchorage Sand & Gravel Co., Inc., was a material man who furnished gravel but was never paid.

The material man then sued on the bond. The surety on the bond claimed that there was no promise to pay material men. However, the court held that the parties (contractor and subcontractor) had intended to benefit material men by providing this additional security as a substitute for the right of lien which they could not have against public property. Thus, the material man was able to recover on the bond, as a third-party beneficiary.

Who's a Contractor?

Martin v. Henderson, 269 Pac. (2d) 117, a California case decided on April 19, 1954, involved the question, "When is a contractor not a contractor?" Martin wanted a house built, and approached Henderson, who was then a licensed building contractor. Henderson quoted a price of \$6500 as the cost of construction of the particular house desired.

It was contemplated that the construction would be financed through an FHA loan from a local bank, but the loan was re-

fused by the banks. Then Henderson began building the house, even though there was no written contract between the parties. Martin claimed the agreement was to build a house for \$6500, with \$300 down and \$50 per month as payments. Henderson said that was contingent upon obtaining a loan, and that when the loan was refused, no specific price was agreed upon. Henderson claims the arrangement was one of mutual help. Martin was to help Henderson tear down a building and Henderson was to help Martin build a house. Martin was to reimburse Henderson for labor (other than his own services) and materials. Incidentally, Henderson took out a \$6500 fire insurance policy on the structure.

Henderson's contractor's license expired and he failed to complete the work. He claims this had nothing to do with his stopping the work, but that it was because he ran out of money. At that time, Henderson claims, Martin owed him \$1666 for labor and materials.

The court held that Henderson was correct. There was "no contract" between the parties. Henderson was not acting as a contractor. Therefore he was not subject to the California statutes involving contractors, and he was allowed to recover the \$1666. ▲ ▲

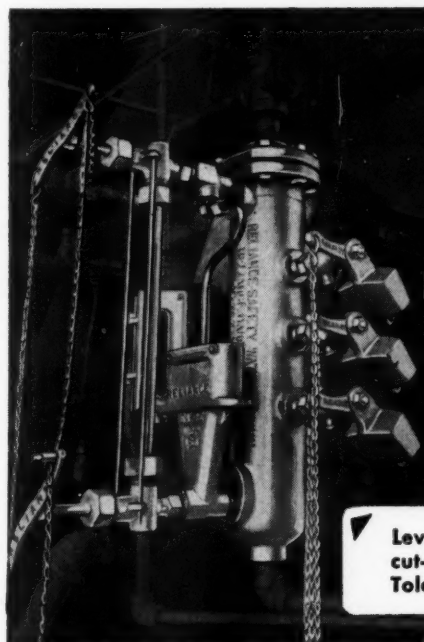
↳ quotes --

In connection with some consulting work for a large American industrial unit last year, three vital new processing techniques . . . were installed. One originated in Poland, one in Sweden, and one in Italy . . . We have been alert in adopting the fruits of foreign research and technical development, which in nearly every instance we have subsequently improved. We frequently lose sight of this contribution to our own economy from outside sources.

J. Carlton Ward, Jr.
President

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Reliance Electrode-Type Levalarms for pressures up to 1100 psi.

You can operate alarms and fuel cut-out, start and stop pumps by means of these latest Reliance devices. Installed on or in the water column, the four models of the new Levalarms provide a desirable selection for various control combinations on boiler pressure from the lowest to 1100 psi. They're ideal for use on package boilers.

Operated by relays and special transformer-created currents, Levalarms are entirely electrical — have no bellows or stuffing boxes, vacuum tubes or magnets. They take their commands from the boiler water itself, as it rises or falls in the water column.

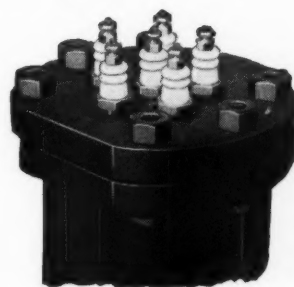
It's easier to understand these devices by reading the special catalog bulletin D2, completely illustrated. Please write for it.

The Reliance Gauge Column Company
5902 Carnegie Avenue • Cleveland 3, Ohio

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Reliance

BOILER SAFETY DEVICES



How electrodes are installed in water column head (and protected by cover) for Levalarms EA17 and 18.





Piasecki Helicopter Corporation

WORLD'S LARGEST TRANSPORT HELICOPTER AGAINST THE PHILADELPHIA SKYLINE IS INDICATIVE OF THE FUTURE.

Planning for Heliports



H. A. SINGER AND J. L. STAUNTON

Supervising Engineers

Seelye Stevenson Value & Knecht

H. A. Singer is supervising engineer with Seelye, Stevenson, Value, & Knecht. He is a civil engineer with wide experience in highway and airfield design, traffic and transportation studies, site planning, and general civil engineering. J. L. Staunton is a graduate of Massachusetts Institute of Technology in sanitary engineering. His present affiliation dates back to 1942, with a three-year leave during World War II. His principal work is in hydraulics, sanitary engineering and site planning.

HELICOPTER DEVELOPMENT has taken tremendous strides in the last few years, spurred by the Korean War. Its extreme maneuverability plus its ability to land and take off almost vertically have made the helicopter without equal in special use such as evacuation of wounded. But what is its potential in civilian, peacetime use? It cannot fly as fast as fixed-wing aircraft and therefore cannot compete on a long-haul basis. On short hauls it cannot carry freight or passengers as economically as automobiles, buses, or railroads.

However, time is money in our age; this factor cannot always be clearly evaluated but nevertheless always exists. For example, ferries are seldom being used in place of more expensive toll-bridge crossings. Helicopter transportation will come into its own when it reduces the overall time-money factor between ultimate destinations to a point where it is more economical than alternate methods of passenger transportation.

Tempo Accelerates

Commercial helicopter operations have been limited until recently to mail, air freight, and charter passenger service. Within the past year, the tempo

of commercial operations has begun to accelerate. The first regularly scheduled helicopter passenger service in the world was inaugurated by New York Airways last summer. Shortly afterwards, Sabena Airlines of Belgium started the world's first international helicopter passenger network; it serves Belgium, France, the Netherlands, and Germany. American helicopter manufacturers have greatly expanded their production facilities and may, within the very near future, reduce their backlog of military orders to the point where commercial craft can also be produced in quantity.

Classes of Service

The report "Transportation by Helicopter 1955-1975" prepared for the Port of New York Authority lists three classes of potential helicopter service. They are aerocab, intercity, and suburban. Aerocab would provide transportation for passengers and freight between municipalities and airport terminals and between airport terminals themselves. Intercity transportation would move passengers and freight between cities, and suburban transportation would serve commuters. These three operations will probably be intermingled in actual practice.

It is obvious that one of the biggest savings to be effected by helicopter travel follows from the fact that the means of transportation will be extremely close to ultimate destinations. This is the key to all planning of transportation by helicopter. A whole new concept must be developed, both with respect to the helicopter's unique movements and to provisions for landing and takeoff facilities.

At present, helicopters can fly during almost the

same weather conditions as fixed-wing aircraft. However, this will not be adequate for the services envisioned; this new-type craft will have to be more dependable than the faster, fixed-wing airplanes. Developments in electronics give promise that this will soon be possible.

At present, helicopter operations are governed somewhat along the same lines as fixed-wing airplanes. This must be changed because it will be essential for these newer craft to maintain tighter schedules, regardless of weather, while operating in relatively confined spaces. At the same time the ultimate in safety must be provided.

Facilities for the landing and take off of helicopters will vary considerably, depending upon their use and location; they will ultimately affect both municipal and building planning tremendously. On one hand, there will be the large heliport which might be similar to a small airport. At the other extreme, there will be myriads of small, rooftop heliports in the midst of intensive business activity and bottlenecked surface transportation; these heliports might be as small as a flat patch approximately 75 feet by 75 feet square. (The present landing pad on the roof of New York's Port Authority Building is about 80 feet in diameter.)

High Roofs

The feasibility of a high-roof heliport (five-story buildings or taller are considered "high" in this sense) is a unique problem. A design study for a rooftop heliport atop a proposed multi-story commercial office building in the heart of New York City indicates to date that this specific project is

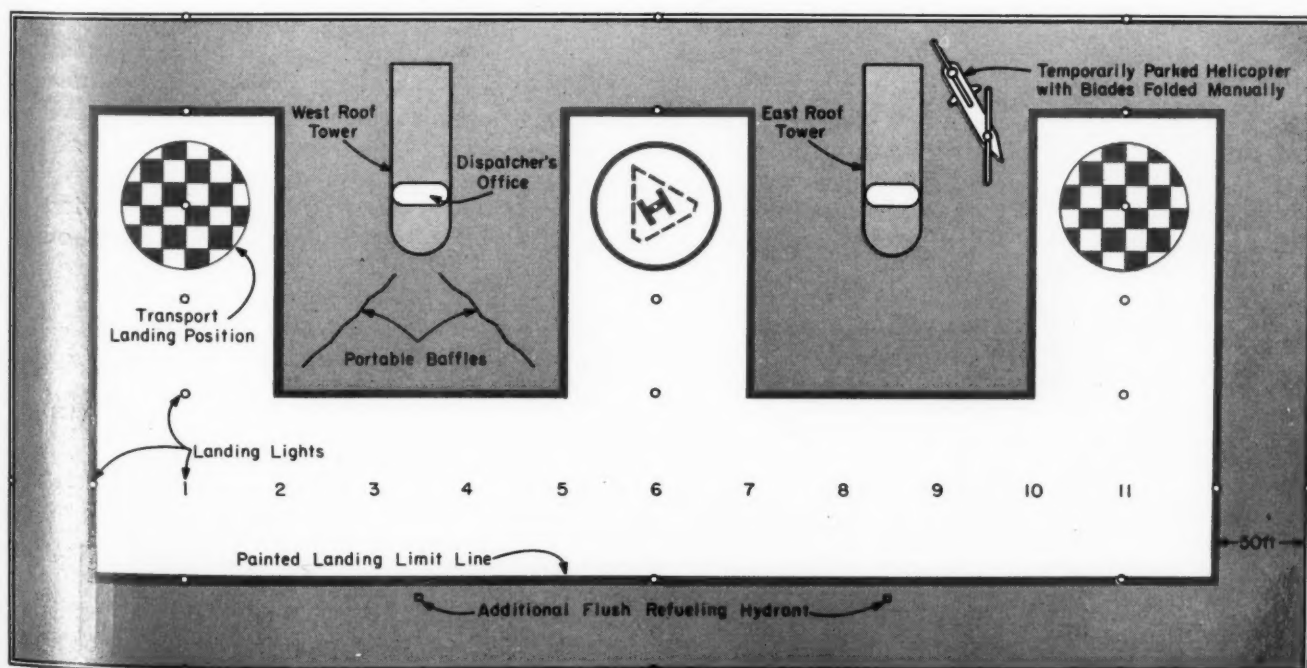


FIG. 1—THIS HELIPORT LAYOUT IS FOR A PROPOSED COMMERCIAL BUILDING IN THE HEART OF NEW YORK CITY. ONE TAKEOFF OR LANDING OF A 40- to 80-PASSENGER HELICOPTER CAN BE HANDLED EVERY TWO MINUTES.

feasible. This is so in spite of the many recognized drawbacks of a high-roof heliport, such as increased size and cost of structural members plus the problem of adequate vertical transportation for passengers, freight, and fuel. In addition to the all important advantage of nearness to major centers of passenger origin and destination, this particular high-roof heliport has advantages in the promise of excellent protective municipal zoning relative to flight obstructions. Noise nuisance to nearby facilities will be reduced by virtue of the building's height.

Roof Loading

On this basis, the solution to the problems of space requirements was to design for the maximum requirement presently anticipated by the majority of manufacturers and operators — a 300 x 200-foot surface at each individual landing or takeoff position. Roof loading was figured for a theoretical 32,000-pound gross-weight craft; 30 passengers plus a 2 man crew multiplied by 1000 pounds per person gave the maximum economic gross weight. Operators and manufacturers would be required to develop special landing gear for heavier craft.

One of the first problems was to decide whether the rooftop heliport should be designed to accommodate known helicopter flight characteristics, or whether the helicopters should be designed to meet the special needs and limitations of rooftop heliports. The decision was that the helicopter manufacturers would find it essential to construct their craft to meet certain prescribed limits in order to make construction of rooftop heliports on economically sound proposition.

Wheel Struts

The maximum static strut loading on dual wheels is 12,000 pounds; this is based upon tricycle landing gear having dual wheels for each strut. Under maximum loading of 32,000 pounds, the theoretical distribution, providing for reasonable eccentricity, is considered to be 12,000 pounds on one strut and 10,000 pounds on each of the other two struts.

Maximum impact is considered to be 22,400 pounds

acting on a single wheel. This load is equal to 70 percent of the gross weight of the helicopter. The contact area for impact is assumed to be a 15-inch diameter circle. This loading should also be sufficient to care for the larger 40- to 80- passenger helicopters that are planned for the future, provided the landing gear of the future craft are properly designed to distribute the load.

The space layout shown in Fig. 1 is in the shape of a letter "E". The combinations of landing patterns that can be used are too numerous to detail. Simply stated, the three legs of the "E" are used for large (40- to 80-passenger), all-weather scheduled transports which could land every 4 minutes using each leg in rotation. This will result in a transport operation (landing or takeoff) every 2 minutes.

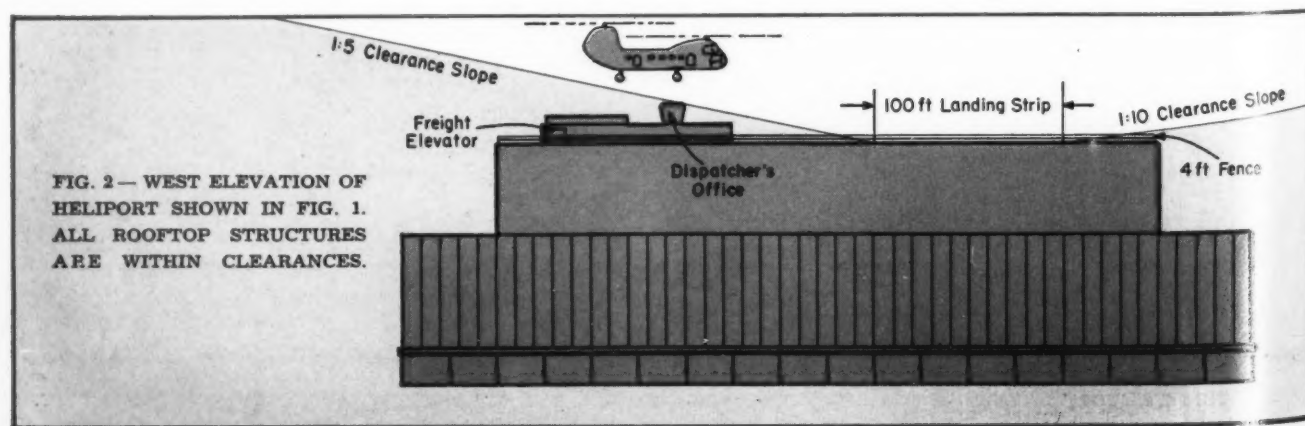
The cycle at each leg — consisting of a landing, unloading and simultaneous loading, takeoff, and next landing — will be 12 minutes. The back of the "E" can be used for landings of smaller aerocabs and aerial "shuttle buses" whose movements can be coordinated with those of the large transports. Storage space is provided for craft which have suffered mechanical failures or must park for some other reason.

Peak Hours

Vertical transportation during the peak hours from the rooftop heliport will be capable of handling 1000 people per hour in one direction and half that in the opposite direction. Freight will travel to the roof in automatically controlled reciprocating lifts.

Clearances in takeoff and landing do not appear to be a problem in the case of this particular rooftop heliport (Fig. 2). But, thinking in this respect appears to be extremely varied — ranging from clearances of 17 vertical to 10 horizontal all the way to 1 vertical to 10 horizontal. Minimum adequate clearance should be 5 vertical on 10 horizontal in three directions, measured from the edge of the landing surface.

A specially designed fireproof heliport wing is proposed for the future to house (among other



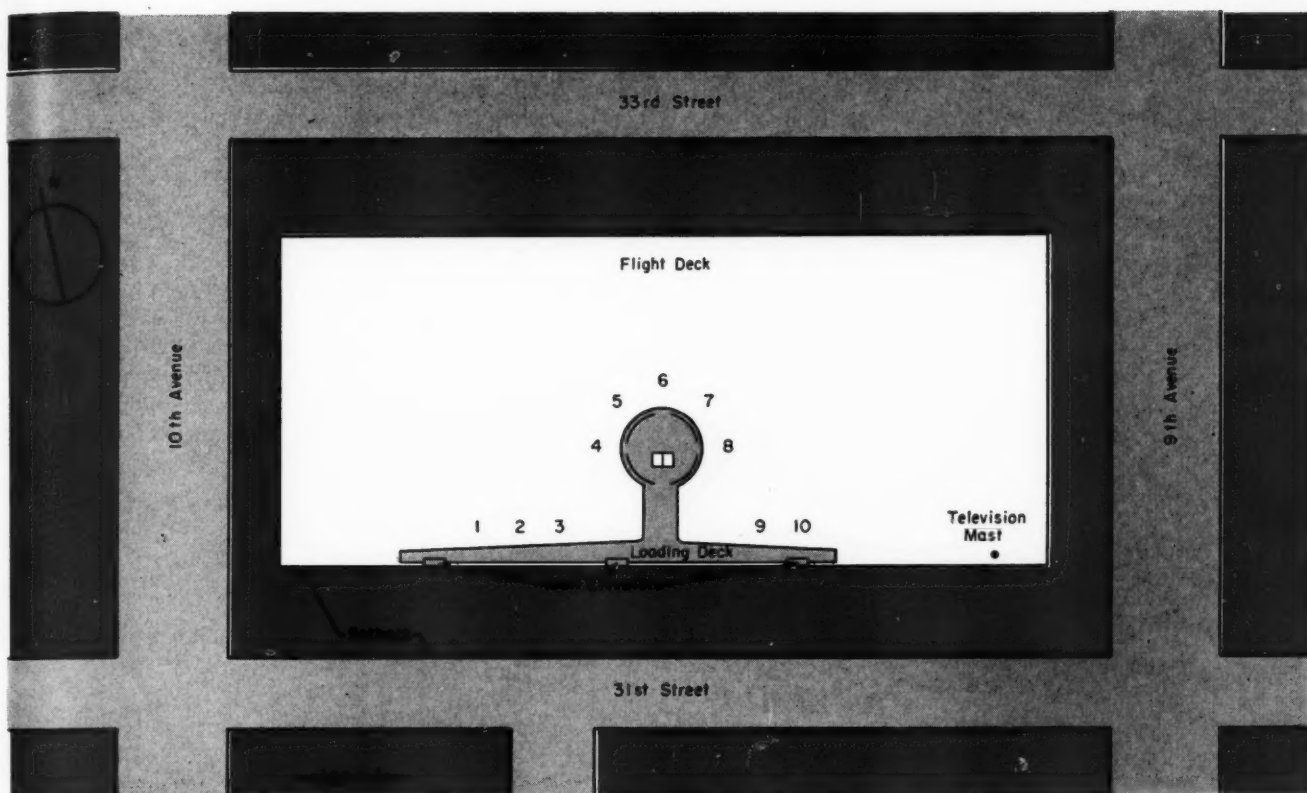


FIG. 3—ANOTHER NEW YORK BUILDING, BEING PLANNED FOR WEBB & KNAPP, HAS TENTATIVE LAYOUT FOR ROOFTOP HELIPORT 20 STORIES ABOVE GROUND. HELIPORT WILL PRIMARILY SERVE POST OFFICE IN BUILDING.

things) piping for the fixed-point, pressure fueling system that may be used at each of the three transport landing positions.

Fig. 3 illustrates the tentative rooftop heliport layout of another project, a midtown commercial building in New York City. This building will be approximately 20 stories high. The primary purpose of this heliport will be to service the proposed post office in the building. Commuter facilities will be at positions 4 through 8. Mail handling will be the remaining positions. The floor immediately below the flight deck is reserved for building utilities plus the office and waiting room needs of the proposed heliport.

This office building project is being designed by Lester C. Tichy for Webb & Knapp, Inc. The engineering phases of this work are being performed under the direction of R. E. Dougherty, of the authors' firm (who are engineering consultants to Mr. Tichy and Webb & Knapp for this project).

The two foregoing examples of rooftop heliports represent the larger end of the scale in rooftop heliport size. There are unique problems at particular sites. The discussion here is not an attempt to set up standards for midtown big-city heliports; it only indicates the scope of some of the problems which consulting engineers will meet in the coming age of helicopters.

Counting Horses

Since the year 1753, when a small engine was brought to the colonies from England to pump water from a mine near Newark, the United States has increased its power-making ability to well over six billion horsepower. That puts the per capita share of the nation's prime mover engines at 39 hp per person. In 1850, there was only $\frac{1}{2}$ hp available per person in the country — a total of but 2 million hp. In a little over 100 years, the horsepower per capita figure has increased 78 times.

The breakdown of this horsepower goes something like this: 92 percent (5.7 billion hp) is found under the hoods of cars, trucks, and buses;

another 1.9 percent (117.9 million hp) are in power stations; farms are a close third with 1.86 percent (115.7 million hp); railroads represent around 1.44 percent (88.7 million hp) and construction equipment follows with 1.26 percent (78.4 million hp). The miscellaneous category — including ships, boats, factories, aircraft, mines, and others — cleans up the remaining 1.9 percent (118 million hp).

Every man, woman, and child has at his disposal on a per capita basis the work equivalent of 782 men; this estimate is based on the common engineering assumption that 1 horsepower equals the steady effort of 20 men.



COAL MICROSCOPIST TAKES COLOR TRANSPARENCIES OF THE MICROSTRUCTURE OF LIGNITE WITH A 35-MM CAMERA THAT HAS BEEN ESPECIALLY ADAPTED FOR USE WITH A RESEARCH MICROSCOPE.

Applications of Coal Microscopy

DR. ALFRED TRAVERSE

Coal Technologist
U. S. Bureau of Mines



MANY PRACTICAL APPLICATIONS of coal microscopy and petrography have been developed in Europe (principally in Germany) and the United States. Fig. 1¹ suggests some of the relationships of this science to the coal-related industries. Microscopic study can reveal that a certain coal bed or part of a coal bed has a high natural concentration of one desired constituent. It also can be used to determine the different physical properties of the microscopically distinct components of a coal and to determine those characteristics that may make possible the concentration of certain ingredients where they are mixed in a coal bed.

Relative concentration of components is particularly significant where it has been established that certain petrographic ingredients possess chemical characteristics that are industrially important. For example, a float and sink technique can be used to concentrate the translucent constituents (anthraxyl-

on and translucent attritus) relative to the opaque constituents (opaque attritus and fusain). Since tar yield is generally higher in the translucent constituents of a coal than in the whole coal, such selective treatment will increase the efficiency of a tar-producing process.

Other techniques for concentrating petrographic constituents depend on other physical properties, such as differences in grindability. In Germany and other parts of Europe, differences in resistance to crushing and milling are the basis for processes that have been developed for concentrating coal types from certain raw coals, thus allowing production of better coke than would be obtained from the whole raw coal. Table 1² shows the natural concentration of petrographic constituents that occurs in the production of various sizes of certain German bituminous coals. A British research team has recently reported successful pilot-plant work on a photoelectric cell technique³ that is based on the marked differences in light reflectivity of petrographic components. In Germany, pilot plant work with some bituminous coals has been published⁴

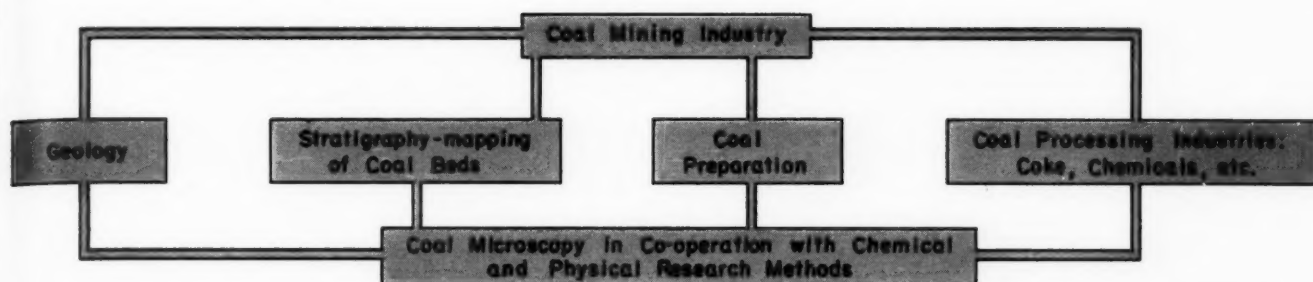


FIG. 1—THIS CHART SHOWS SOME OF THE RELATIONSHIPS OF THE SCIENCE OF COAL MICROSCOPY TO INDUSTRY.¹

showing that it is possible to increase considerably the percentage of desired petrographic components, and to reduce the percentage of ash, by electrostatic techniques. The method depends on differences in surface conductivity of the different components.

Industrial Fuel Utilization

Within rather broad limits, the petrographic nature of coals is unimportant in the industrial use of coal as a fuel. Providing the thermal value is acceptable, industrial combustion equipment can be designed to burn almost any coal. However, once equipment that was designed for burning coal with a certain content of volatile matter and ash is in operation, it may be useful to insure a supply of coal with a relatively constant petrographic composition so that the fuel will have constant burning characteristics.

If the mineral matter in a given coal forms an ash with a low fusion (melting) temperature, clinker formation on the furnace grate may be very troublesome. Under such conditions, microscopic study would be valuable in establishing the distribution of the mineral matter in the coal. This information could be used to indicate good techniques for reducing mineral matter and preparing a low ash coal.

Domestic Fuel

When coal is to be used for home or other small scale firing, preparation of coal relatively rich in or free from certain petrographic components has advantages. Domestic heating equipment is not designed to handle large quantities of mineral matter,

and reducing this item is always beneficial. Reduction of fusain also improves coal for domestic handling because fusain is typically friable and structurally incoherent. As a result, it is usually very dirty and a great offender as a source of dust.

Fusain, however, does have a high carbon content and a satisfactory heating value. Also, because of its low volatile content, fusain burns with little smoke. Separated fusain removed in preparing clean coal can be treated with a binding substance and pressed into small blocks (briquets) that make good fuel.

Coke Production

In Europe (principally in Germany) coal microscopy has been used extensively in research on the production of coke from coal. In this country there also has been research on the effect of petrographic composition of coals on the quality and quantity of coke produced from them. Practical application of the technique in industry, however, has received very little attention.

Coals that are not far apart in chemical analysis can be quite dissimilar in coking behavior. European researchers have found that such differences in behavior of coals in the coking ovens are often correlated with microstructural differences among the coals. In European practice it has been found possible to produce good cokes by blending either whole coals that do not coke satisfactorily alone or specially prepared fractions of coal beds that are selectively enriched in content of a desired petrographic component. For example, a certain coal may

TABLE 1—CONCENTRATION OF THE PETROGRAPHIC COMPONENTS OF COAL IN PERCENT FOR DIFFERENT PREPARED SIZES OF SOME GERMAN BITUMINOUS COALS (A).

| Coal size | Bright coal | Dull coal | Fusain coal | Carbonaceous shale: "Bone" |
|--------------------------------------|------------------------|------------------------|-------------|----------------------------|
| Coarse Nut (about 0.7 to 3.1 in.) | 27 (Vitrif) | 54 (Vitrif and Clarif) | 6 | 13 |
| Fine Nut (about 0.3 to 0.7 in.) | 65 (Vitrif and Clarif) | 23 (Durif) | 5 | 7 |
| Fine Grain (about 0.04 to 0.3 in.) | 76 " | 6 | 9 | 9 |
| Very Fine Grain (less than 0.04 in.) | 68 " | 2 | 12 | 18 |

A. Adapted from Kuhlwein².

The petrographic terms (Vitrif, Clarif, and Durif) used here are explained in "Coal Microscopy—An Important Research Technique," *Consulting Engineer*, July 1954.

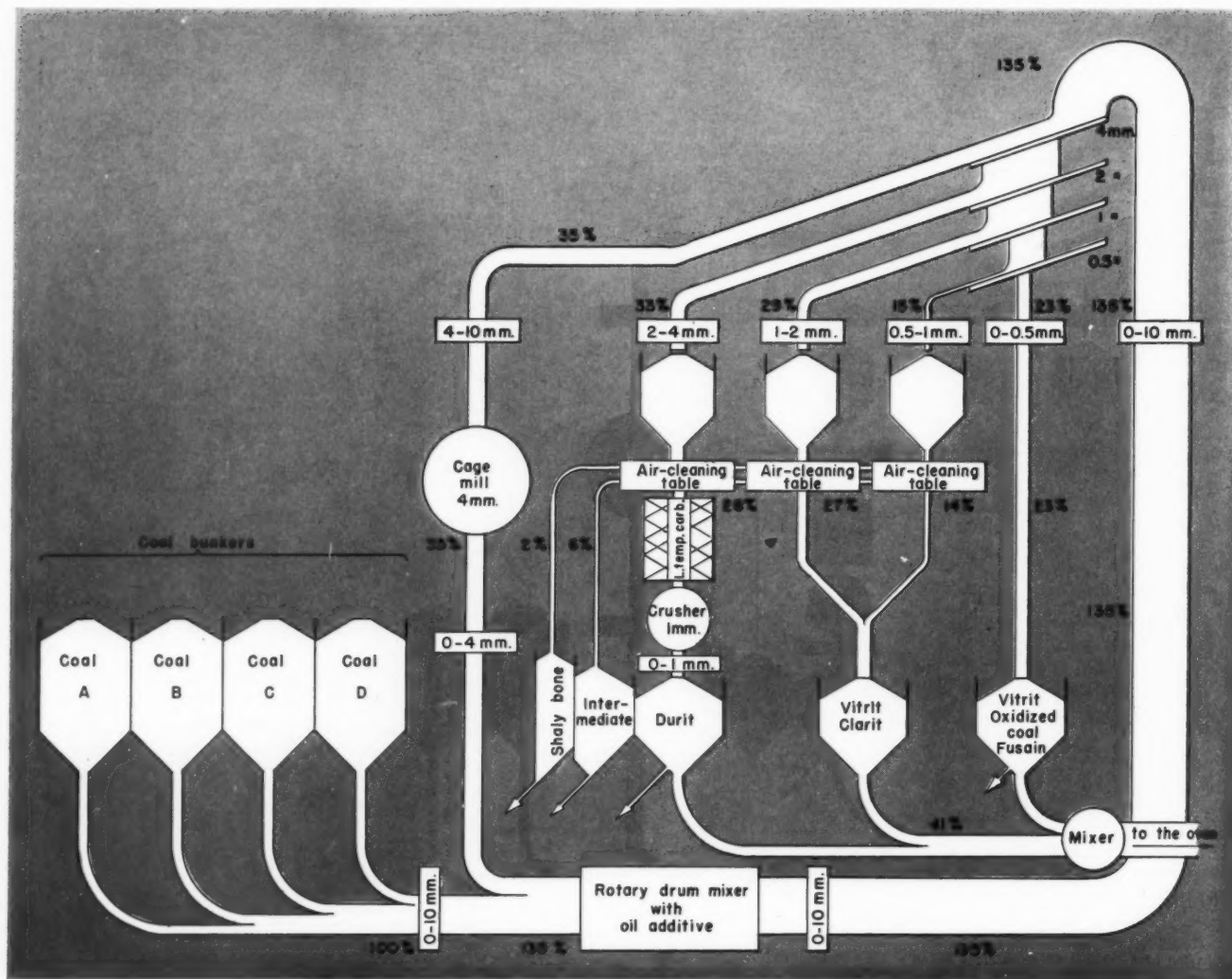


FIG. 2—PETROGRAPHIC PREPARATION OF COKING COAL AS PRACTICED AT THIONVILLE (DIEDENHOFEN), FRANCE.⁵

need more inert matter to produce a good coke. Addition of a fusain-rich fraction of another coal will correct this deficiency. Fig. 2⁵ is a flow diagram of a system employed at Thionville (Diedenhofen), France, for beneficiation of coal for coking, according to the petrographic composition desired in the coal to be charged to the coking ovens. Some work has been done on the petrography of American coking coals, but much more research needs to be done on the relation of microstructure to coking behavior.

Coal Hydrogenation

Extensive basic research by the U. S. Bureau of Mines has proved that the petrographic composition of coal, as revealed by microscopic study, is highly correlated with the yield of liquid products and solid residue in the hydrogenation of coal. Fusain and opaque attritus give relatively low yields of liquid products and leave large amounts of residue after hydrogenation. Translucent components (anthraxylon and translucent attritus) give relatively high liquid product yields.

Bureau of Mines scientists⁶ have been able to pre-

dict rather well from the microscopic study of thin sections of a coal what the yield of products of hydrogenation would be. The results they obtained probably would have agreed even more closely with the predictions if the translucent attritus of the coals had been analyzed further for petrographic subconstituents. The waxy parts of the attritus (spores, pollen, cuticles, and so forth) are more amenable to liquefaction by hydrogenation than are other parts of the attritus.

Low Temperature Carbonization of Coal

Destructive distillation of coal in the absence of air at 450 to 700 C (approximately 850 to 1300 F) is called low temperature carbonization. This temperature is much lower than the temperature (900 to 1100 C) used in the carbonization of bituminous coal to make metallurgical coke. Low temperature carbonization of bituminous coals produces high yields of tar and light oil and a solid residue of low temperature coke, which is an excellent smokeless fuel if the size distribution of the particles is satisfactory. The tar is rich in phenolic compounds,

from which wood preservatives can be made. Other uses include the manufacture of plastics and drugs.

Low temperature carbonization techniques also can be used with lignite. The char produced as a residue has a higher heating value per unit of weight than raw lignite, and the tar obtained is a valuable chemical raw material. At Dickinson, North Dakota, Dakota Briquets & Tar Products, Inc., utilizes a version of this process in which briquets are made from pulverized char using pitch produced from the carbonization tar as part of the binder required for the briquets. In Rockdale, Texas, the Texas Power & Light Company plans to burn the char produced by carbonization of Texas lignite to generate power for a new, large scale aluminum smelting operation of the Aluminum Company of America. The distillate tars will be used as a chemical raw material.

The petrographic composition of some coals is closely related to their behavior in low temperature carbonization. This is illustrated by Table 2, which gives data⁷ for six samples of American lignite. As might be expected, petrographic components with the highest content of volatile matter (translucent attritus and anthraxylon) give the greatest yield of tar. Those examples of translucent attritus that are highest in waxy and resinous matter give the highest tar yields of all.

Extraction of Waxes From Low Rank Coal

In Europe, montan wax has long been extracted from lignitic coal, using benzene or benzene-alcohol mixtures as the extracting agent⁸. Because of its high melting point and hardness, this wax is valuable for use in polishes, protective coatings, and various other products. Montan wax also is being produced domestically — The American Lignite Products Co., Buena Vista, California, now has a plant for extracting montan wax from California lignite.

Research by the Bureau of Mines on the problem of wax extraction from lignite has shown clearly that microscopic features of structure are the most important factor in determining yields⁸. Lignites that are high in attrital content give highest

yields, and the more waxy the attritus, the higher the yield. So-called canneloid lignites, which contain relatively large amounts of pollen, spores, leaf cuticles, and resinous matter, provide the best yields of wax.

Coal Briquets

Briquets are compact lumps made by compressing small particles of fuel, with or without a binding agent, depending on their microstructure. Where briquets are made from coal, as they are in great quantities in Germany and elsewhere for both domestic and industrial use, the structure of both the coal used and the resulting briquets often is examined microscopically. Such study aids understanding of variations in quality of the briquets and helps explain why certain coal types are more readily briquetted than others.

In Germany large amounts of lignitic coal are made into briquets to improve ease of handling and firing. Microscopy has been of considerable use in explaining the nature of the briquetting process and in helping assure a uniform product. At present, lignite briquets are not widely used in this country because the lignite of our largest deposits (in the North Central United States) is not considered to make good briquets without carbonization and use of considerable quantities of binder, making the process economically marginal. Much of the German lignitic coal can be briquetted by heat and pressure without added binder. Research in Germany has shown that the briquetting process depends largely on the plasticity of the coal used under given conditions of operation. The natural plasticity of attrital lignite under usual briquetting conditions is greater than that of hard and anthraxylous lignite. The lignite of the North Central United States is predominantly anthraxylous.

Coal Dusts

Research on dusts of all kinds depends heavily on microscopy for identification of the substances

Continued on page 74

TABLE 2 — CORRELATION OF PETROGRAPHIC COMPOSITIONS AND TAR YIELDS OF SEVERAL AMERICAN LIGNITES (TAR BY FISCHER LOW TEMPERATURE CARBONIZATION ASSAY AT 500 C. ALL DATA ON DRY, ASH FREE BASIS). (A).

| Variety of Lignite (B) Type | Subtype | Source of Lignite | | Proximate Analysis, % | | | Ultimate Analysis, % | | | | | Thermal Value Btu per lb | Tar Percent |
|--------------------------------|-----------|-------------------|----------|-----------------------|------|-----|----------------------|------|-----|------|--------|-----------------------------|----------------|
| | | State | County | V.M. | F.C. | S | H | C | N | O | | | |
| Attrital | Canneloid | Arkansas | Ouachita | 60.0 | 40.0 | 0.7 | 6.2 | 73.9 | 1.2 | 18.0 | 13,120 | 19.8 | |
| Attrital | Canneloid | Arkansas | Ouachita | 55.9 | 44.1 | 0.8 | 6.1 | 73.7 | 1.3 | 18.1 | 13,190 | 20.5 | |
| Attrital | Humic | N. Dakota | Divide | 46.7 | 53.3 | 1.0 | 5.2 | 73.7 | 1.3 | 18.8 | 12,600 | 8.8 | |
| Xyloid | — | N. Dakota | Mercer | 43.7 | 56.3 | 1.0 | 4.6 | 72.8 | 1.0 | 20.6 | 12,120 | 5.4 | |
| Xyloid | — | N. Dakota | Stark | 50.6 | 49.4 | 0.7 | 5.1 | 71.8 | 0.6 | 21.8 | 12,180 | 6.9 | |
| Xyloid | — | N. Dakota | Ward | 43.2 | 56.8 | 0.3 | 4.2 | 72.7 | 1.2 | 21.6 | 11,710 | 5.0 | |

A. Adapted from Table 4 in Selvig, W. A.⁷

B. Attrital: Composed predominantly of translucent attritus.

Canneloid: Attrital lignite composed largely of spores, pollen, cuticular and resinous matter.

Humic: Attrital lignite composed largely of degraded plant parts that were originally cellulose and lignin.

Xyloid: Composed predominantly of anthraxylon.



Ryan

SURFACES BEING COATED WITH REFRACTORIES REMAIN RELATIVELY COOL DURING FLAME SPRAYING, THUS MAKING IT POSSIBLE TO COAT MATERIALS WHICH CANNOT WITHSTAND KILN TEMPERATURES.

Flame Spraying Increases

Ce exclusive

Versatility of Refractory Coatings

FRANK CHARITY

FLAME-SPRAYING techniques are now being used to apply refractory coatings to aluminum, stainless steels, titanium, and many other materials. Developed by Ryan Aeronautical Company, the technique involves the use of a more or less conventional powder-type metallizing gun to eject refractory particles onto various deposition surfaces by means of an open gas flame.

Ryan developed this new method to provide a means of applying refractories to metals with relatively low melting temperatures. Previously, refractory or porcelain-enamel coatings were applied as water dispersions which subsequently had to be dehydrated and then heat-fused in high-temperature furnaces or kilns. Besides involving high equipment and operating costs, this procedure made refractory coatings practical only for the finishing of a few iron and steel materials, because the deposition surfaces

had to have more heat resistance than their coatings in order to withstand kiln firing temperatures.

With flame spraying, relatively little heat is conveyed to the metal receiving the coating because the spray gun is in constant motion and the heat-softened powder particles are subject to rapid cooling after they are fused onto the deposition surface.

Types of Refractories

Most of the production coatings now being used by Ryan are the A-418 ceramic composition, recently developed by the National Bureau of Standards to conserve critical metals by permitting more plentiful types of steel to be used for parts requiring high heat resistance. Porcelain enamels and other conventional refractories can be flame sprayed, however, and there is evidence to indicate that parts requiring maximum heat resistance will eventually be finished with such cermets (combinations of metals and ceramics) as nickel-magnesia.

PROPERTIES OF TYPICAL CERAMIC COATINGS

| | |
|--|--------------|
| Specific Gravity | 1.55 to 2.40 |
| Mechanical Strength | Negligible |
| Heat Resistance | 2000 F |
| Thermal Shock Resistance | Excellent |
| Machinability | Good |
| Weldability | Good |
| Color Effects | Opaque |
| Resistances to Most Acids | Excellent |
| Resistance to Most Alkalies | Excellent |
| Resistance to Oil, Water, and Organic Solvents | Excellent |
| Tendency to Oxidize | None |
| Vibration Resistance | Excellent |

In industries using ceramic coatings for chemical resistance at room or slightly-elevated temperatures, virtually all refractory compositions, including glass, can be satisfactorily flame sprayed on either metallic or nonmetallic deposition surfaces. Where refractories are used primarily to increase heat and oxidation resistance of metals, however, there are a number of limitations to the flame-spray process because coatings and deposition materials with varying thermal expansion coefficients separate at high temperatures. Further research is now underway to eliminate most, if not all, of these limitations.

The A-418 composition is primarily suitable for high-temperature protection of "superalloy" steels, titanium, Inconel, and stainless steels. Following an application, it can be machined where close dimensional tolerances are specified. If finished parts must

be welded, it will serve as a flux in preventing oxidation when welding takes place.

Service data obtained by Ryan indicate that A-418 coatings increase the lifespan of aircraft engine components by 50 to 100 percent. Typical parts being finished are combustion chambers, exhaust manifolds, and afterburners. The latter must withstand temperatures of as much as 2000 F.

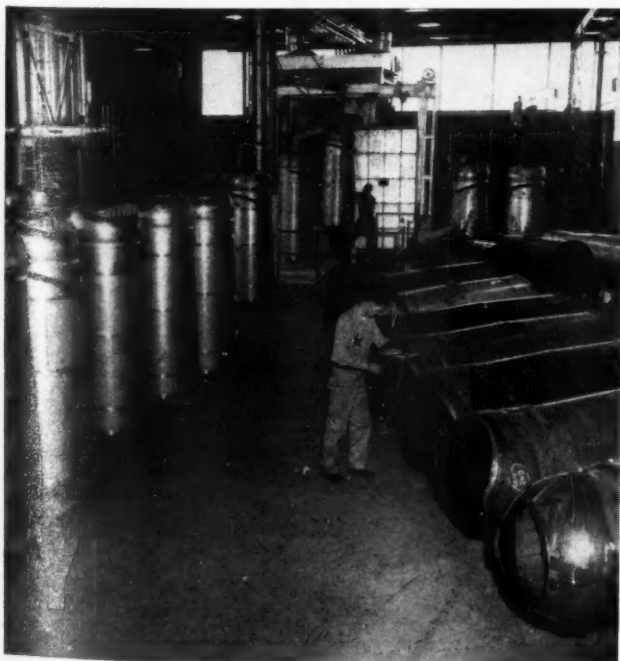
Most of the other refractories now being used to finish aircraft parts are materials that have been specially developed by the National Bureau of Standards. They are considered superior to the A-418 composition only where thermal expansion characteristics make the use of A-418 impractical.

Applying the Refractory

The parts are prepared for coating by carefully cleaning and roughening their surfaces. Refractory coatings are then applied as layers with thicknesses ranging from 0.001 to 0.020 inch. As a rule, there is no need to preheat deposition materials.

The flame spray gun is held in about the same way that a conventional pneumatic spray gun would be held, except that the distance between the gun and the deposition surface is greater, and rapid passes must be made over an area about a yard square to avoid melting or oxidizing the surface.

No special precautions are necessary to avoid oxidation of the flame-sprayed ceramics since the coating materials already consist of metallic oxides. Special inert-gas spray equipment may be essential, however, to the successful application of certain types of cermets. ▲ ▲



Ryan

REFRACTORY COATINGS ARE USED BY RYAN TO INCREASE THE LIFE OF JET ENGINE AFTERBURNERS.



Ryan

REFRACTORIES ARE APPLIED BY MAKING RAPID PASSES OVER AN AREA ABOUT ONE YARD SQUARE.

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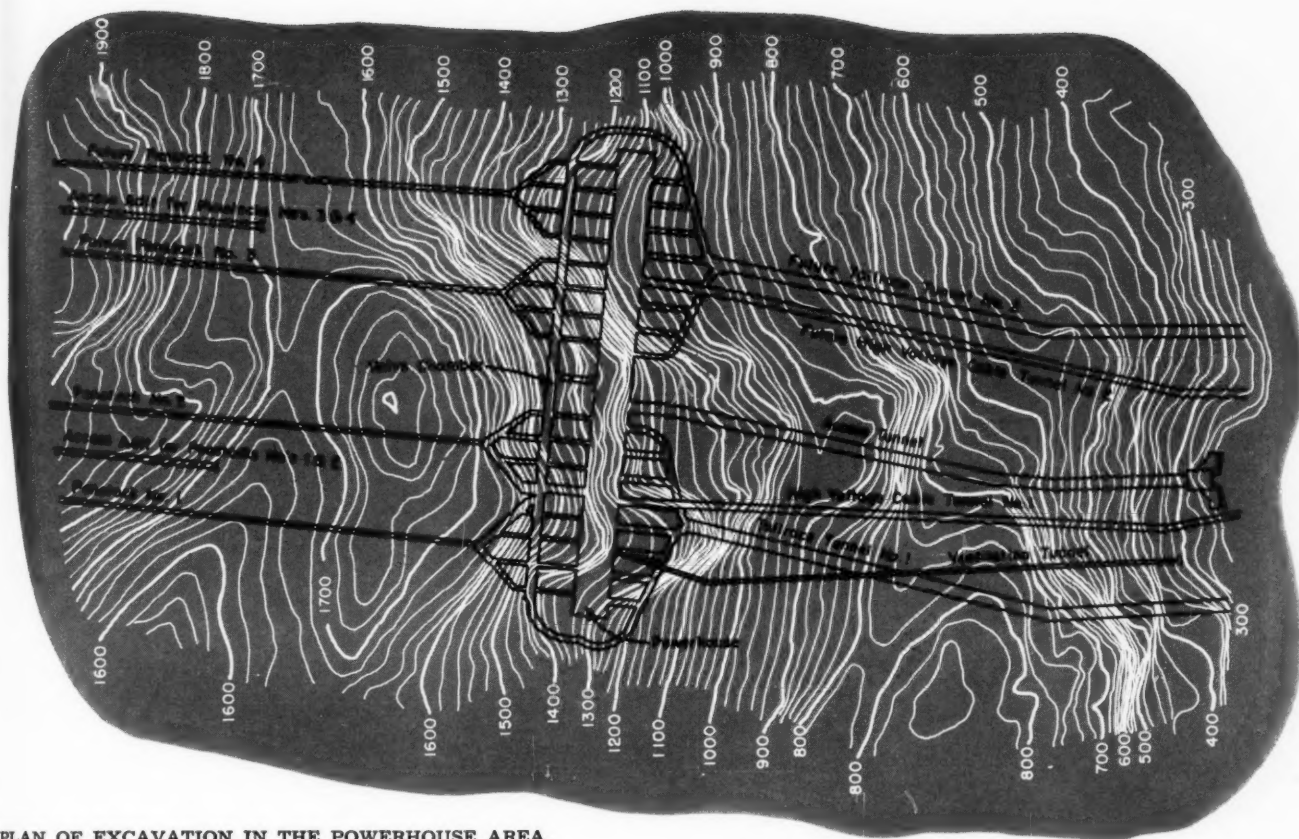
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PLAN OF EXCAVATION IN THE POWERHOUSE AREA.

How Alcan's Power Plant Went Underground

exclusive

W. G. HUBER, General Manager
British Columbia International Engineering Company Ltd.

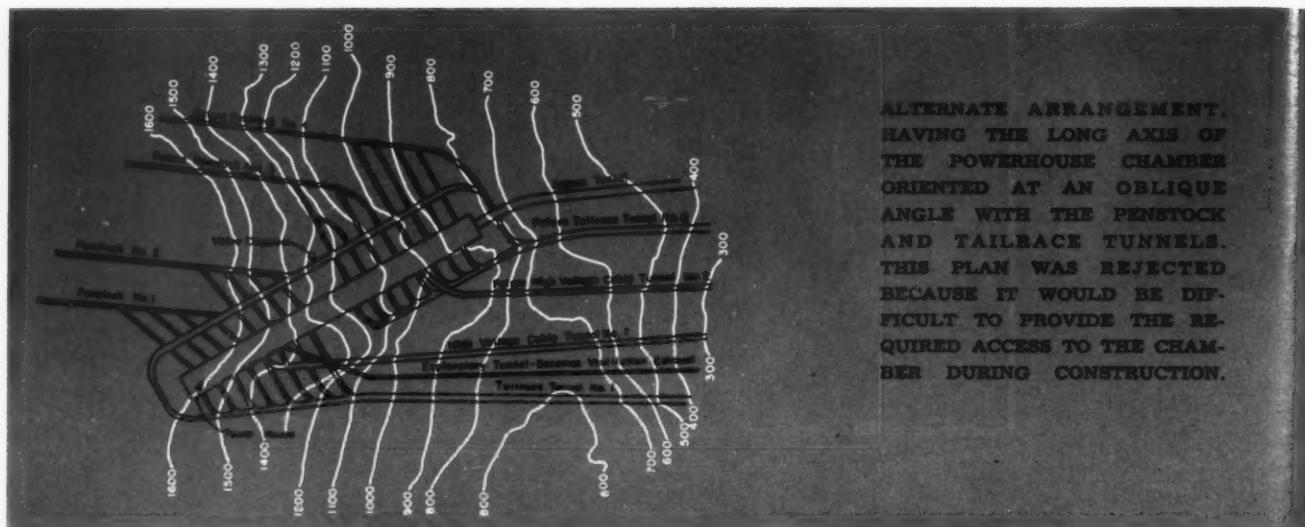


A MAJOR feature of the gigantic aluminum smelting industry in British Columbia, being completed for the Aluminum Company of Canada, Ltd., is an underground hydroelectric power plant, believed to be the largest in the world. Power from this plant will be transmitted 50 miles, over rugged mountain ranges, to supply electrical requirements of the new ocean port and huge aluminum smelting facility at Kitimat.

When fully developed, the Kemano power plant will feature sixteen generating units with a total rating of 2,240,000 hp, housed in an underground chamber 1000 feet long, 82 feet wide, and 135 feet high. Approximately 70 percent of this chamber is being built in the first stage of the installation.

Cost of locating the plant underground is obvi-

ously higher than for a semi-underground powerhouse notched into the toe of the mountain, but the additional cost was felt to be outweighed by the complete safety which the underground plant affords



against snow or rock slides and against bombing in wartime, the assurance of sturdy rock foundations for all heavy machinery, the uniformity of temperature and humidity conditions, and the possible reduction in maintenance expense.

Plant Layout

Several layouts were originally made to locate and orient the required chamber with respect to the other components of the installation. All too little was known of the important subsurface conditions,

but it was necessary to settle on a general arrangement promptly to avoid delaying the contractor. Since the tunnel location and alignment of the underground penstocks were rather closely fixed by considerations of topography and construction access, the location of the powerhouse was limited to a relatively small area between the proposed lower end of the penstocks and the westerly contact of Mt. DuBose with the left bank of the Kemano River. Also, a rock formation was required in which excavation could be made with a minimum of



Aluminum Company of Canada
EXPOSED ROCK SURFACES ON THE LEFT WALL OF POWERHOUSE WILL LATER BE HIDDEN BY CONCRETE BLOCK WALL.

temporary and permanent supports, and located so as to provide at least 300 feet of rock thickness above the proposed roof arch.

The need for supports and overbreak in excavation would be reduced by a favorable relationship of the chamber and tunnels with the joint systems of the rock mass, and examination of the surface geology indicated three major joint systems which could be expected to prevail throughout the end of the mountain. One system dips approximately 45 degrees to the west—about parallel to the surface slope. A second system is nearly at right angles to the first system, dipping eastward into the mountain, and the third system roughly intersects the first and second at right angles, with a steep dip to the north.

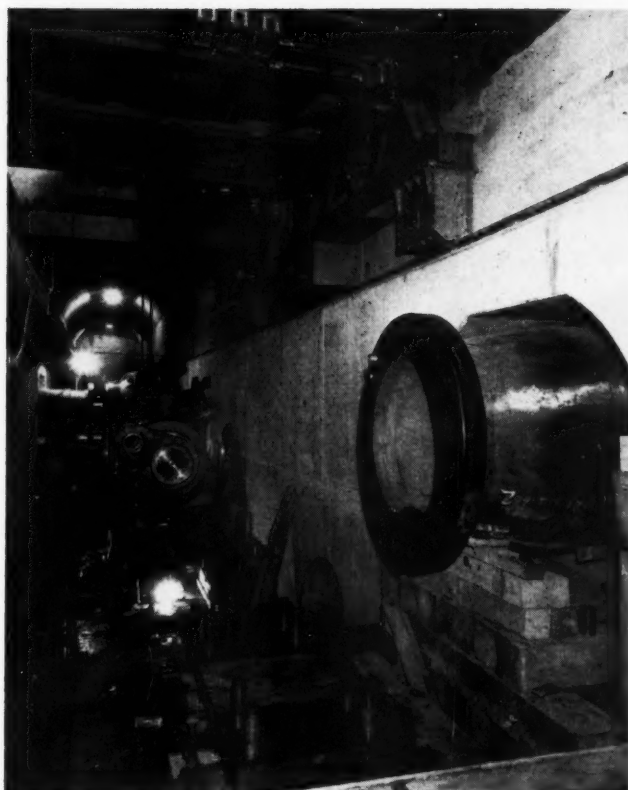
Penstock shafts would be approximately perpendicular to the second system of joints, which was considered favorable, and horizontal sections of the underground penstock plus the access, tailrace, and cable tunnels to the powerhouse would all cross the first and second systems of joints at angles of about 45 degrees. Since any excavations at right angles to the general east-west line of the tunnel and penstock would follow the strike of the first two joint systems, it was reasoned that unstable rock would be encountered in each side of the proposed roof arch—thus causing increased expense.

Consequently, several studies with the long axis of the powerhouse chamber oriented as closely as possible to the east-west direction of the mountain were made to compare costs with an orientation at right angles to the established tunnel and penstock alignment. Principal variables entering these studies were lengths and hydraulic efficiencies of penstocks, elevations of turbine distributors, lengths of access, tailrace and cable tunnels for future and initial powerhouses, and problems of construction access to the deferred portion of the main chamber.

Square or Angled Orientation

The penstocks for the "square" orientation would be about equal in length for all units, while in the "angled" orientation, the penstocks for the first half of the powerhouse would be somewhat shorter and those to be built in the future would be longer. Hydraulic efficiency would be higher for the angled arrangements because the total bend in the pressure line would be only about half as large.

Total length of first-stage tailwater and cable tunnels, however, would be considerably greater for the "angled" arrangement, and the turbine setting would have to be at a higher absolute elevation to maintain equal clearance above tailwater at the upper end of this longer tunnel. It would be especially difficult to provide good access to an "angled" chamber, since any tunnel to the center of the long chamber would include undesirably sharp curves, and access through the future end portion has obvious disadvantages.



Aluminum Company of Canada
UNFAVORABLE ROCK IN THE VALVE CHAMBER AREA
LED TO 100% INCREASE IN THE CONCRETE LINING.

While these office studies were proving that the differences in total estimated cost for the several powerhouse arrangements were too small to be decisive, an exploratory tunnel, approximately parallel to the tunnel-penstock alignment, had been driven near the springline level of the proposed chamber's roof arch. Diamond drill holes were fanned out horizontally to explore the formations in the rock, and the results indicated a very complex and variable system of jointing.

Thus, little reliance could be placed on one orientation as against another with respect to the cost for temporary and permanent supports. Accordingly, when the exploratory drift had traversed a sufficient thickness of more promising rock with ample roof cover, a decision was made to adopt the "square" orientation of the powerhouse chamber. This provided for completion of the access tunnel in the initial construction phase, and insures less interference with the operating portion of the plant when the southerly extension of the chamber is constructed in the future.

While making the preliminary powerhouse studies, division of the entire powerhouse into two parts of eight units each also was considered. This arrangement would have a connecting tunnel between the two chambers, which would be at angles of about 45 degrees with the penstocks. The ultimate plant would have been V-shaped. Such an

arrangement, however, would have required duplicate powerhouse crane equipment and would increase costs of future completion.

Rock conditions encountered during construction proved the general rule that even with the most thorough exploration feasible by present methods, estimates of underground work should include substantial allowances for conditions which cannot be known until excavation is actually made.

Excavation

In this instance, each of the three major joint systems became, in turn, dominantly important with respect to stability of the rock surfaces exposed in the main chamber. The third system governed throughout the northerly several hundred feet of the chamber, which favored the adopted orientation. But near mid-length and in the valve chamber, the second system became the more important and accounted for the largest amount of overbreak anywhere in the excavation.

Variation in attitude of joint planes was prevalent and quite unpredictable. Where the dip of the first system approached the vertical, large slabs of granodiorite almost in the plane of the chamber walls were exposed. Here, the better position would have been at right angles to that adopted, but it is now the consensus that quality of rock would have averaged about the same for any orientation of the chamber within the general location. The overbreak averaged 39 percent, based on concrete quantities outside the design neat lines for the first 700 feet of the arched roof. Span of the arch is 102 feet, and the rise is 38 feet.

A power plant located 1500 feet inside a mountain is not greatly different from a conventional water power station with respect to the hydraulic and electrical conductor patterns. The tailwater tunnel is merely longer than average and covered. The cable tunnel resembles many hydro plant switchyards where step-up transformers are located close to the generating units, except that the ties between transformers and high-tension breakers are made with relatively long, oil-filled cables. The oil-filled cables are, in effect, extensions of transformer high-tension bushings.

Unusual Conditions

Ventilation and lighting, however, do involve problems not encountered in the design of an outdoor station. To be considered are the psychological effect on operating personnel required to spend their working hours underground, the total dependence on artificial ventilation and light for safety and comfort of employees, and the probability of high humidity levels.

In the Kemano installation, the outer end of the cable tunnel is substantially closed, thus leaving but three openings available for ventilation from the



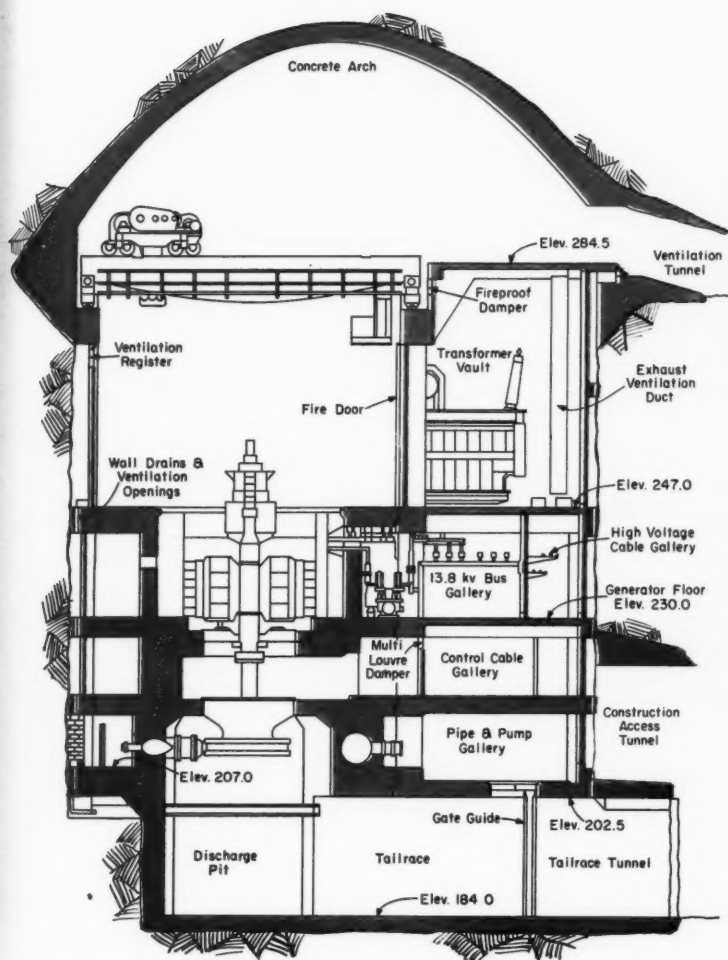
Aluminum Company of Canada
VIEW OF EXCITER FLOOR. LARGE PIPE ON FLOOR
BEYOND GENERATOR ROTOR IS UNIT PENSTOCK LINER.

outside of the mountain. These are the upper portion of the tailwater tunnel, the exploratory tunnel, and the main access tunnel.

Ventilation Requirements

Required temperature and humidity levels in the several parts of the plant vary according to their utilization. Humidity will generally be somewhat greater than desirable, and air supply and heat must be regulated to limit condensation of moisture and prevent corrosion of equipment and structural parts. The exciter floor and most of the storage and shop spaces in the service bay require little artificial heating, but the atmospheric conditions in the control and office bay must approximate those of any office building.

If necessary, warm air from the generators can be vented to the generating room. These generators are totally enclosed, and are normally air-cooled by air recirculated through heat exchangers using tailwater as the coolant. Considerable heat also is given off by the main transformers, but the air in these normally closed cubicles will carry some odor



GENERAL ARRANGEMENT OF POWERHOUSE. OPENINGS IN FLOORS PROVIDE AIR CIRCULATION BEHIND CURTAIN WALLS.



International Harvester
INTAKE OF TEN-MILE TUNNEL FOR CARRYING WATER FROM RESERVOIR TO PENSTOCKS 1 & 2.

of warm oil and therefore must be exhausted upwards and out of the main chamber.

Although earlier powerhouse designs utilized the upper portions of the tailwater and access tunnels for high tension cables and ventilation, the radius of curvature permissible for the oil-filled 301-kv cables, the elevation of the tailwater tunnel with respect to powerhouse galleries, and the contractor's plan for construction all made it desirable to provide a separate tunnel for the cables plus related fire protection and ventilating equipment.

The original plan for the main air intake called for a horizontal partition at the springline elevation of the 27 x 27-ft access tunnel, but the cost of this partition was avoided and velocity of air currents reduced by employing the entire cross-section of the tunnel as a supply duct.

Distribution of Air

The air passes through the tunnel to a fan room at the inner end, where it is heated, cooled, or washed as required. Passing through the control cable gallery, it is then distributed outwards through

louvres and upwards to the large space between the exciter floor and the arched roof. Design conditions for the air in this space are 69 F with 40 percent relative humidity.

The air from this area flows in four principal directions, most of it passing through wall grilles and floor gratings. A portion goes to vertical spaces behind concrete block curtain walls, located between the columns and the chamber rock walls, so that some air movement can take place through combination drain and vent holes at each floor level. This system has been used in underground powerhouses recently constructed in Europe to eliminate the effects of moisture on the interior faces of powerhouse walls.

A second portion of the exciter room air supply is recirculated downwards to the discharge pit under each operating turbine to prevent drowning out the runners. This air exhausts to the tailwater tunnels.

A third portion of the air ventilates the transformer vaults, and the remainder becomes supply for an otherwise independent fan and duct system provided in the control and office building. The air

from all the rooms is then exhausted to the outside through the exploratory tunnel. Thus, this tunnel becomes an essential part of the ventilation system as well as an escape route for personnel in the event of an emergency.

Safety Features

Every known safety device and feature has been incorporated in the design to prevent and extinguish fires. For example, the supply and exhaust ventilation grilles for each of the transformer vaults are provided with fusible elements which will close the louvres in the event of a fire and shut off the air supply. To relieve pressures which might otherwise blow out the main transformer vault doors, the ceiling of each vault is pierced by a large hatchway covered by lightweight sheet metal. This sheet metal will be blown off by even a minor explosion in the vault below. The smoke and gases, released under these conditions, will follow the path of normal exhaust air from all rooms and will be forced to the outside of the mountain through the exploratory tunnel.

In the original plans, a major feature of the powerhouse arrangement was to be a suspended ceiling over the exciter and assembly floor spaces. The space between this ceiling and the roof arch

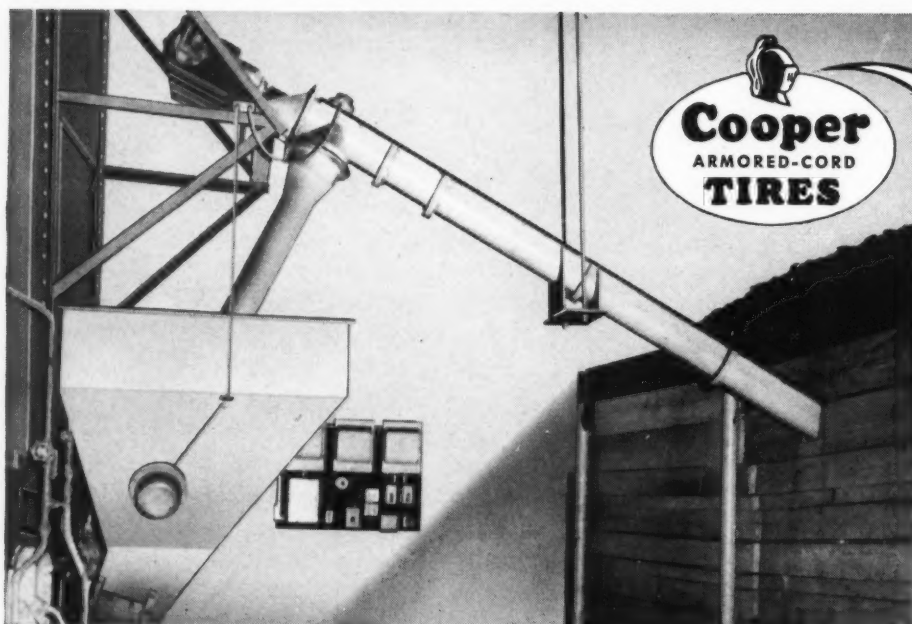
was to have formed a plenum chamber through which air could be drawn to exhauster fans located at the ventilation tunnel. However, because of the architectural effect of concrete roof arches, it was decided to use a cast concrete arch instead. Although an equivalent of the plenum chamber is not being provided in the initial construction stage, a large duct along the roof of the transformer vaults will be necessary to direct exhaust air away from the exciter room before the powerhouse chamber is completed.

Lighting

Since the powerhouse is underground, it is entirely dependent upon artificial lighting. Two diesel-engine generator sets in the access tunnel portal building supply station service power when it cannot be taken from the main generator buses.

Failure of all a-c power on the exciter floor will leave only the dome lights on the pilot exciters operating on direct current for lighting the main chamber. However, in the generator and turbine floors below the exciter floor and downstream galleries at these levels, sufficient d-c lighting will be available to continue operation of the plant, and emergency lighting from the station battery will be available in the control and office bay. ▲ ▲

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How You Can Compete

For Top-Talent Graduating Engineers

JOHN F. LEE, Professor of Mechanical Engineering
North Carolina State College

SMALL CONSULTING ENGINEERING firms do not need to be reminded of the critical shortage of graduating engineers. Faced with the somewhat higher salaries, the heavily subsidized recruitment programs, and the glamor of the large industrial concerns, the small consulting organizations must often accept the less qualified graduates if they are fortunate enough to obtain any candidates at all. And, the annual crop of graduating engineers is expected to become even more inadequate during the next few years.

Can the small consultants hope to improve their competitive position? Certainly they cannot compete with the large industrial companies on the same terms. It is doubtful that personnel budgets can be increased to permit annual contacts with the colleges when new personnel are not required. A costly promotional program would be out of the question for most consulting offices, although a coalition of a number of firms could improve this situation without undue expense to any one member. Salary scales and other benefits could be made more attractive,

but for many companies this is not a likely prospect.

Clearly, if the small consulting firm hopes to compete, it must develop unique recruiting techniques which are effective, yet suited to its means. Such techniques can be developed, and the time to begin is now.

The recruiting techniques of many different types of firms demonstrate that consultants need to devote more thought and effort to the problems of attracting young engineers. It appears that consultants have not sufficiently recognized the fact that they have within their grasp one of the most appealing attractions for young graduates. The consulting firm is usually a small, personal organization where individual achievement can be quickly recognized and rewarded. Should there be any doubt about the effectiveness of this appeal, one has only to observe that the large industrial firms are constantly emphasizing that their organizations are not impersonal but are quick to recognize individual merit.

For the majority of students, the appeal of the small firm is powerful. The fault does not lie in what the consulting engineering firm has to offer the graduating engineer but rather in the way the message is brought to the student.

What Students Look For

The defects in the recruiting techniques employed by small consultants are more clearly discernible against a background of the student's attitude towards his first job. Most companies are known to him through the products they manufacture. He is looking for stability in the company with which he is to cast his lot, and the size and prominence of the firm are often taken as criteria of stability. The opportunity for advancement, and a climate which makes it possible for the contributions of the individual to be recognized also are highly prized virtues.

The student expects an adequate salary and is not

impressed by the fact that starting salaries were very low ten or fifteen years ago. Many graduating engineers are married, or expect to be shortly after graduation. However, the student is not preoccupied with the size of the starting salary but is more concerned with the salary possibilities after he has been with the company a number of years.

Most of all, the graduating engineer wants his identity as an individual to be preserved so that greater responsibility can be shouldered as quickly as he demonstrates the ability to accept it. These attitudes are characteristic of the best students, even though it cannot be said that they are representative of every student.

Defects in Recruiting Methods

How does the graduating engineer determine whether a company offers the opportunities he seeks? The answer to that question is the clue to the inadequacies of the recruiting techniques used by small consulting firms. Since consulting engineering firms do not manufacture products, they are less likely to be familiar to the student. Furthermore, personnel are not usually recruited every year, and the student is not in a position to learn of the company through former classmates who have accepted jobs.

To many students the consulting engineer is an accomplished expert, and an organization of experts would appear to have little sympathy or use for an inexperienced engineer. Indeed, it is in this area of clearing up misunderstandings and providing information about their companies that the small consulting firms demonstrate their greatest weakness. Too often they merely send a representative whose arrival on the college campus is announced by an inconspicuous note on a bulletin board. Since personnel are not needed every year, this representative appears infrequently. Is it surprising that few students show up for the interviews?

What happens to the students who are interviewed? In some instances the company is looking for a draftsman and not an engineer. No matter how an individual feels about the importance of drafting experience, it is a simple fact that the engineering schools no longer produce draftsmen. The interviewer would be well advised to seek that type of personnel elsewhere. Because of abuses in the past, drafting is thoroughly discredited as an internship for engineering in the eyes of students.

Opportunities with small consulting companies are not always made clear to the student. Some of these firms appear as closed partnerships or seem to be dominated by family interests. If the candidate is expected to accept a lower starting salary and to cast his lot with a small organization struggling for growth, he must be convinced that he stands to share in the fruits of his efforts. If future opportunities exist, they need to be pointed out as definite possibilities for the employee who makes superior



JOHN F. LEE

Professor Lee is well qualified to appraise the problems that consulting engineering firms encounter

in their efforts to attract the best talent among graduating engineers. Before entering the teaching profession, he spent more than six years with Stone & Webster Engineering Corp. He has authored several textbooks, and a number of his technical papers have been published. He is a registered engineer, and a member of ASME and ASEE.

ADDRESSING STUDENT CHAPTERS OF THE ENGINEERING SOCIETIES DOES NOT REQUIRE MUCH TIME OR MONEY, BUT IT IS AN EFFECTIVE MEANS OF CARRYING THE CONSULTANT'S MESSAGE TO THESE STUDENTS.



contributions to the development of the firm.

One other practice deserves mention, not because it is prevalent but because of the possible far reaching effects it may have on the public relations of all small companies. In a few isolated instances, small industries and consulting firms whose activities are confined to a single state have attempted to exert pressure on tax-supported schools of that state to secure the services of graduating engineers. As taxpayers they feel that the institution and the students owe them a peculiar kind of loyalty. Such an attitude is not only immoral but it defeats the very purpose it is intended to achieve.

It should be remembered that the students or their parents are taxpayers too. Furthermore, despite state support, four years of college represents considerable personal sacrifice on the part of students and their families. Above all else, the institution exists for the benefit of the student and all other allegiances must occupy a secondary position.

Cooperating With Student Chapters

The most important task for the small consulting engineer firm, in improving its recruiting techniques, is to get its message across to the prospective candidate. One very effective method is through the student chapters of the engineering societies. Most chapters would be delighted to have engineers address their meetings on the function of a consulting engineer, and personal association with the students in their society activities would do much to create a climate of understanding. This does not require much time or money, and should be carried out on a continuing basis.

Another possibility is for a group or organization of small consulting engineering firms to cooperate in issuing a booklet explaining the nature of consulting work, the opportunities for development and advancement, the variety of challenging activities, and the advantages of working with a small company. These booklets could easily be placed in the

hands of every student early in his senior year.

A very effective plan is for the interviewer to visit the campus early in October in order to obtain a list of the best qualified students from the professors. This should be followed by a letter to each of these students explaining the nature of the openings and the distinctive opportunities offered, and inviting him to an interview at a later date. The professors are probably familiar with the company, but if not, they should be briefed on its activities. Remember, the students often go to the professors for advice.

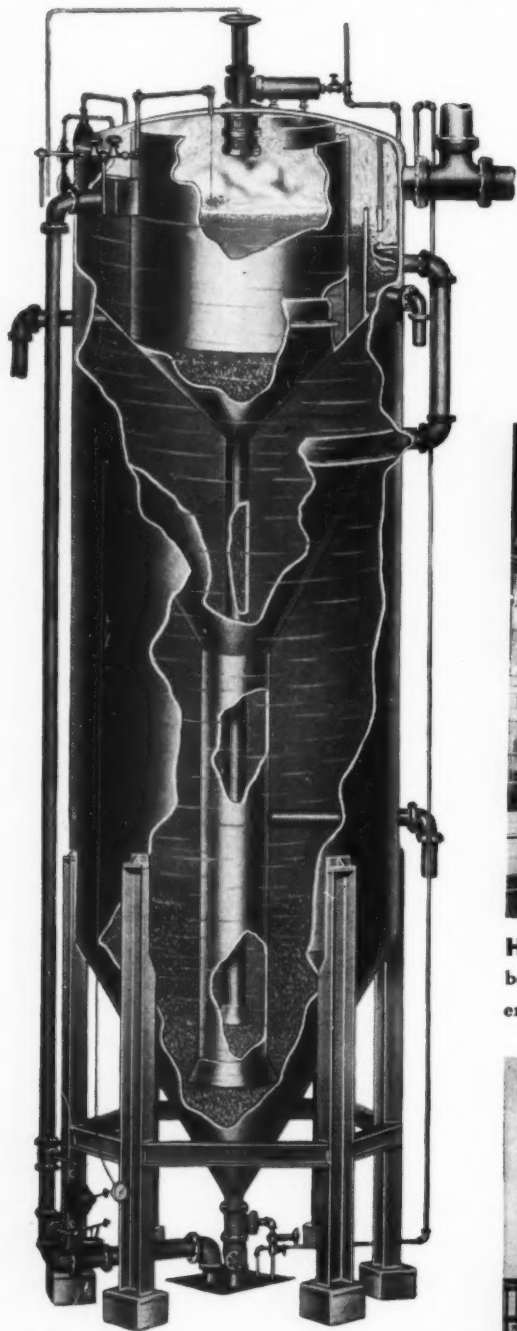
Summer Work

Hiring students for summer work between their junior and senior years has been found by some companies to be the most effective recruiting technique at their disposal. This scheme has dual advantages, since it not only affords an opportunity to observe a possible candidate, but also it permits the student to become acquainted with the company. The percentage of students who eventually come to the company on a permanent basis is very high under this plan. As a dividend, when the student returns for his senior year he becomes, in effect, an ambassador of good will for the company.

Although the recruiting efforts of small consulting engineering firms have not been too gratifying, this situation can be corrected. All that is needed is an understanding of the viewpoint of the graduating engineer, some missionary work to explain the function of the consulting engineer and the advantages of working with a small firm, and the exploitation of opportunities to speak to the students in small informal groups.

The professors and administrators of nearly all schools are willing to cooperate with any company in furthering their students' understanding of career opportunities. Full use should be made of this avenue of communication. It is also important that initial contacts with prospective candidates be made early in the senior year. ▲ ▲

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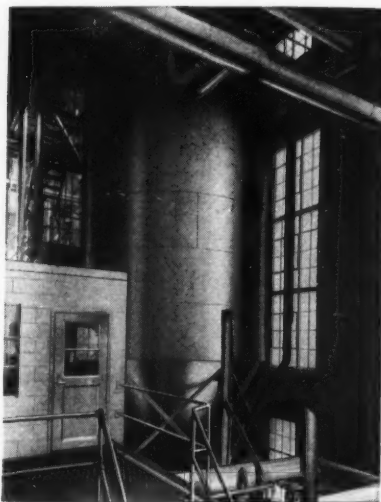
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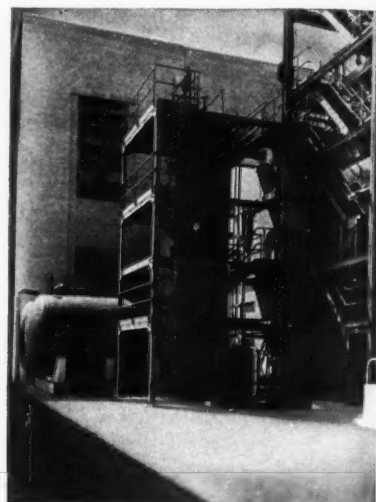
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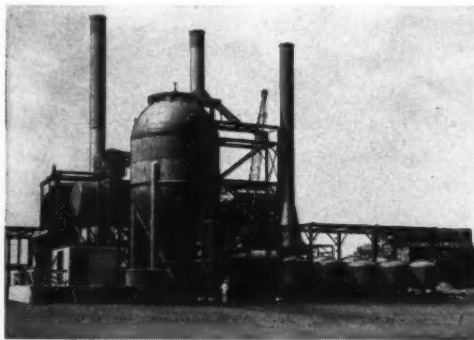
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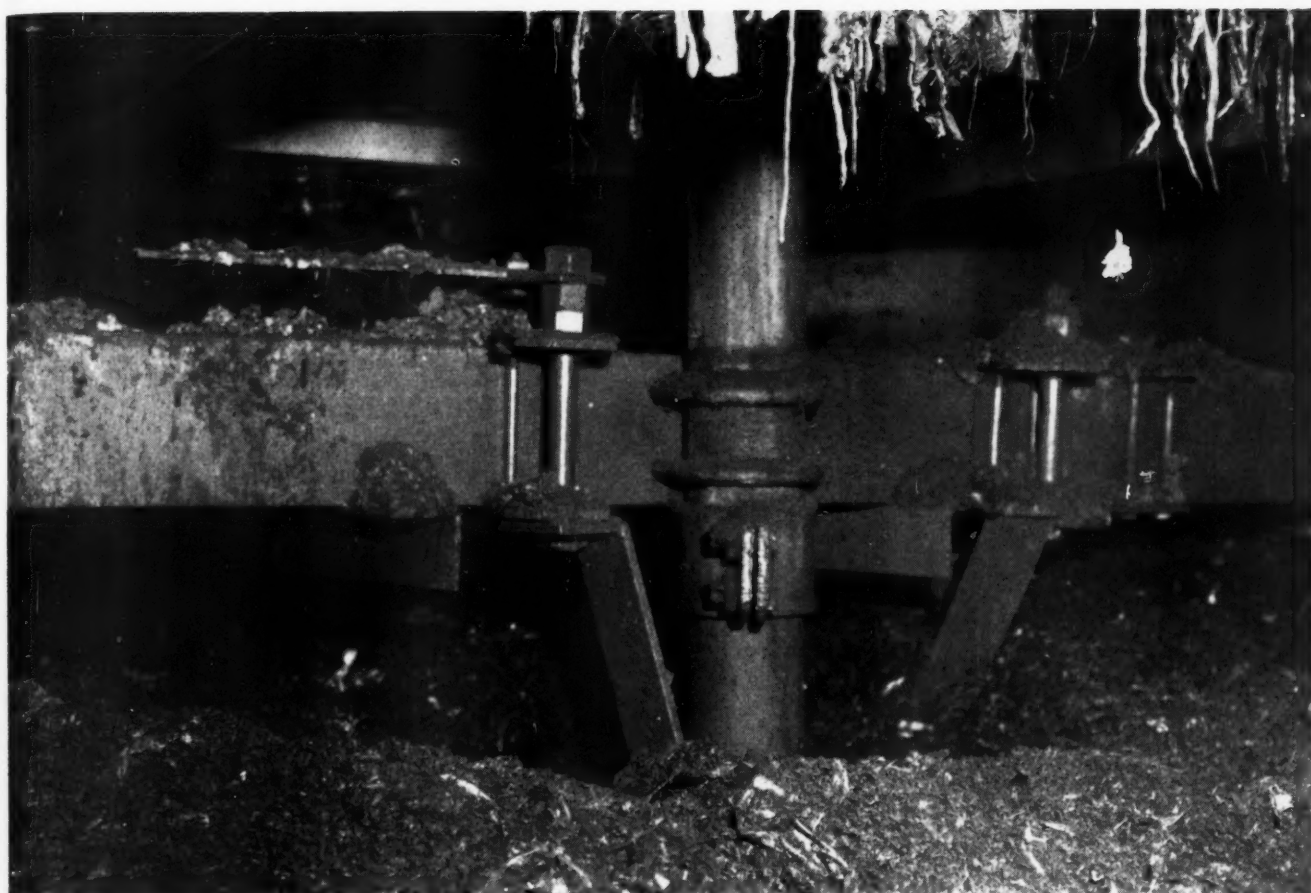
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CONSULTING ENGINEER



RAW GARBAGE IS AERATED AND MIXED BY PLOWS AS IT SLOWLY DROPS FROM DECK TO DECK DURING DIGESTION.

High-Rate Composting

A New Idea in Municipal Garbage Disposal



JOHN R. SNELL, Head, Department of Civil and Sanitary Engineering, Michigan State College

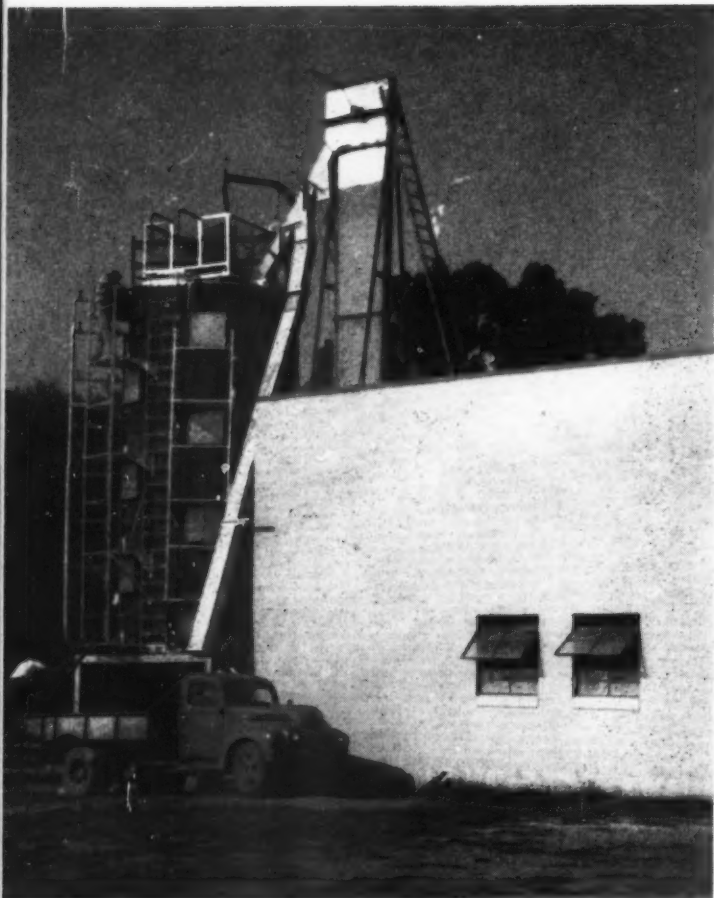
HIGH-RATE COMPOSTING can convert raw organic wastes, such as garbage or the more putrid and dangerous sewage solids, into a stable organic fertilizer in 2-3 days. Bacteria that thrive at high temperatures feed on the unstable portions of these wastes producing temperatures of about 150-165 F which is sufficient heat to kill all disease producing organisms.

The high-rate composting process is totally enclosed. However, even when it is opened and inspected, it offers no objectionable odors. Flies and rodents are not attracted to the dry end-product. Furthermore, the end-product will not create odors if wetted down—as do unstable organics. Although it is desirable to remove bottles and cans prior to grinding, this is not essential to the process. Com-

posting is also free of any ash or residue problem. An average composition of composed garbage is 3 percent nitrogen, 2 percent phosphorus, and 1 percent potash.

A high-rate composting process is actually being made to work today. It is expected that the essential information required to design, construct, and efficiently operate a composting plant will be available within the next 12-18 months. Even before this, certain high-rate composting plants may be designed because they will be more economical to build and operate than conventional methods of waste disposal.

The composting process has three major advantages: 1) it is an efficient sanitary method of treatment and disposal for most organic wastes; 2) it is a



THE COMPOSTER AND RESEARCH BUILDING ARE LOCATED ON THE CAMPUS OF MICHIGAN STATE COLLEGE.

profitable method of treatment; 3) it returns valuable wastes to our organically depleted lands.

Profitable

It is believed that—for all but small plants—finished compost can be produced at about \$10 per dry ton (20 percent moisture) or \$2.50 per ton on the basis of wet, raw garbage (75 percent moisture).

If the organic fertilizer were thrown away, the composting process would still be less expensive than incineration (which averages around \$4 per wet ton). Since a 75 percent shrinkage in the total weight of the wet garbage occurs, the sale of the dry end-product at \$20 per ton would be equivalent to a net profit of: \$5 less \$2.50 costs or about \$2.50 per wet ton of garbage. As compared to incineration, this would mean a net financial gain of \$2.50 profit plus \$4 savings of incineration costs or about \$6.50 gross savings per ton of wet waste.

Annual Value

To estimate the national economic value of composting: There are about 12,500 municipalities in the U.S. with an average population of 8000 or a total population of roughly 100 million persons. Taking garbage, sewage solids, and industrial wastes at approximately two pounds (wet) weight per person

per day, gives 36 million wet tons or 9 million dry tons of organic waste per year. Assuming an average waste content of nitrogen, phosphorus, and potash (3 percent, 2 percent, and 1 percent respectively), and the fertilizer market value as \$400, \$200, and \$100 per ton respectively, the annual value of all the potential compost in this country is summarized as follows:

| | |
|----------------------------------|---------------|
| 270,000 tons of nitrogen | \$108,000,000 |
| 180,000 tons of phosphorus | 36,000,000 |
| 90,000 tons of potash | 9,000,000 |
| 8,460,000 tons of organic | 169,200,000 |
| (at \$20 per ton) | |

Total estimated annual value\$322,200,000

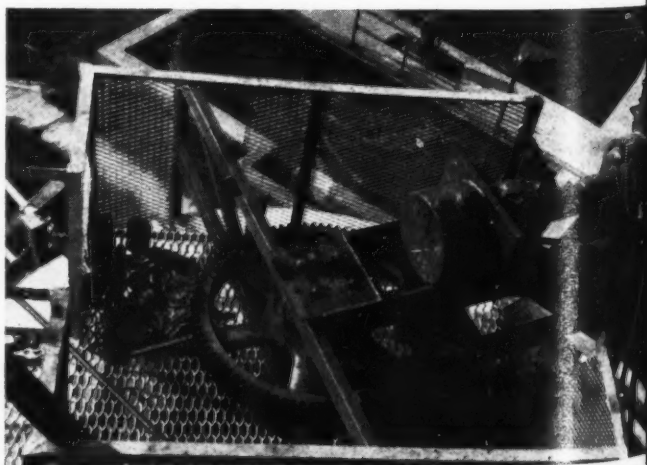
Organic Material

Compost returns valuable wastes to our organically depleted lands. It has been demonstrated that nitrogen, phosphorus, and potash in organic form, or at least in the presence of organic material, is more valuable as a fertilizer than it is in the inorganic form—primarily because in the organic form it is less soluble and is gradually released and used by the growing plant more efficiently over a longer period of time.

It is likely that compost will, in many cases, be fortified with nitrogen, phosphorus, and potash prior to being sold. Further basic research in the value of natural compost and fortified compost is in the planning stage at Michigan State College.

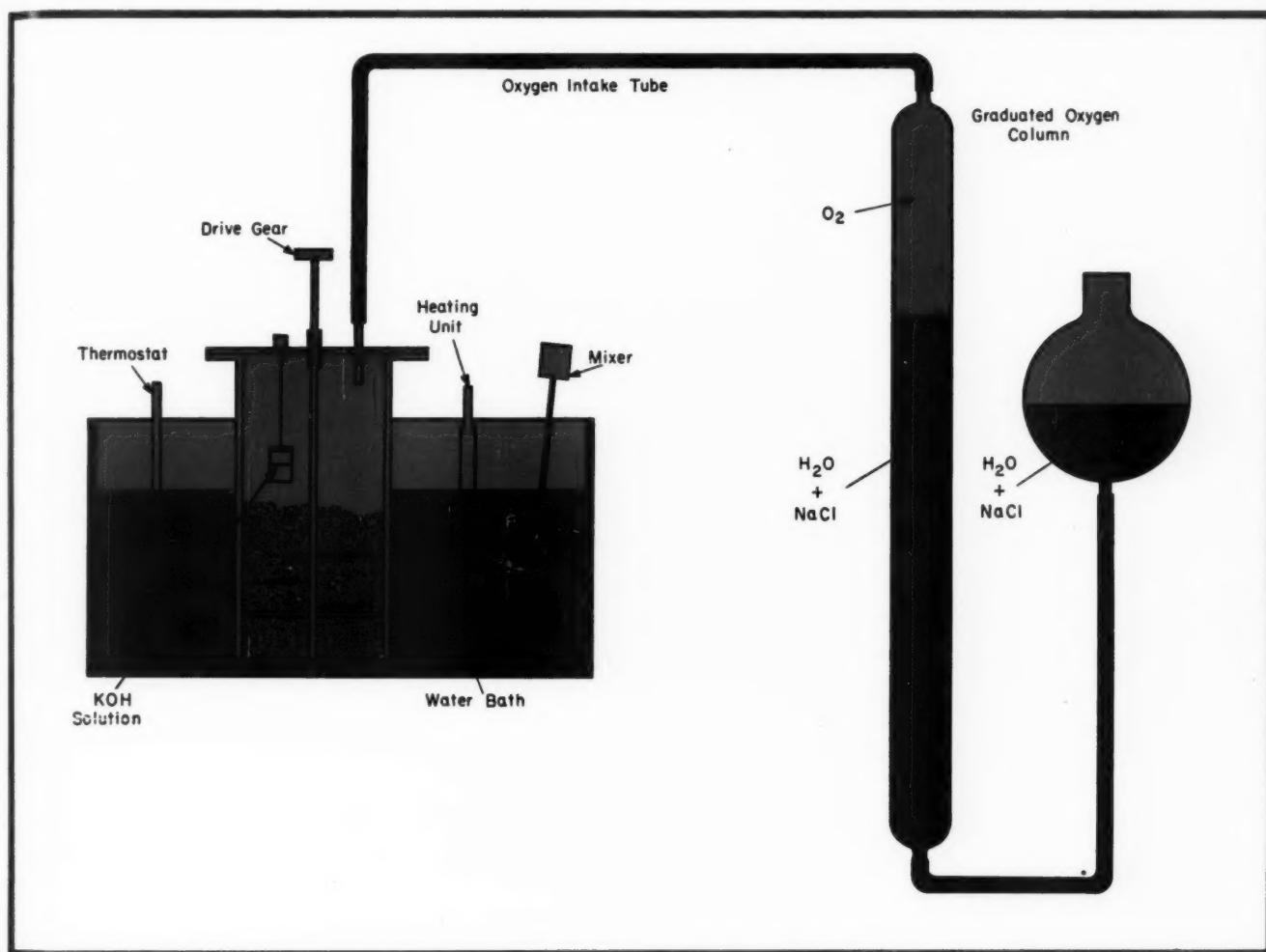
Present Methods

Different composting techniques have been tried with varying degrees of success. In Holland, the V.A.M. composting method takes 3-6 weeks in the summer and 4-6 months in the winter. Twelve communities in Denmark are using the Dano process which consists of a preparatory grinding and rasping operation for their waste followed by on the



A TOP VIEW OF THE DRIVE MECHANISM THAT REVOLVES THE MOUNTED CROSS-ARMS AND PLOWS.

CONSULTING ENGINEER



BY OPERATING AND OBSERVING THE CHEMICAL AND BACTERIOLOGICAL REACTIONS IN 22 OF THESE CONTROLLED EXPERIMENTAL ONE-POUND DIGESTERS, DATA WAS COLLECTED TO HELP DESIGN THE FULL-SCALE COMPOSTER.

ground composting with no further treatment.

Earp-Thomas

In the U.S., the Chicago Stock Yards method for composting their wastes takes 6-10 days of pre-digestion by windrowing with 4-6 days of batch digestion and drying—the material being turned over each hour. The Frazier process uses a silo with four decks. The material is dumped periodically from deck to deck during a four week period. The four plants constructed in the U. S. using the Frazier process have all been unable to maintain areobic conditions. The American Compost Corporation process utilizes a double walled silo type structure and recirculating seeding liquids, but were unable to maintain aerobic conditions at two trial plants. The process takes 30 days. The method of windrowing on the ground and turning every few days has obvious drawbacks because of the nuisance created by odors and dust, and by the flies and rodents it attracts. In many areas there would be further troubles during wet and freezing weather.

The Earp-Thomas method is probably the best commercial process available today. The digester employed, however, has grave weaknesses. Chief

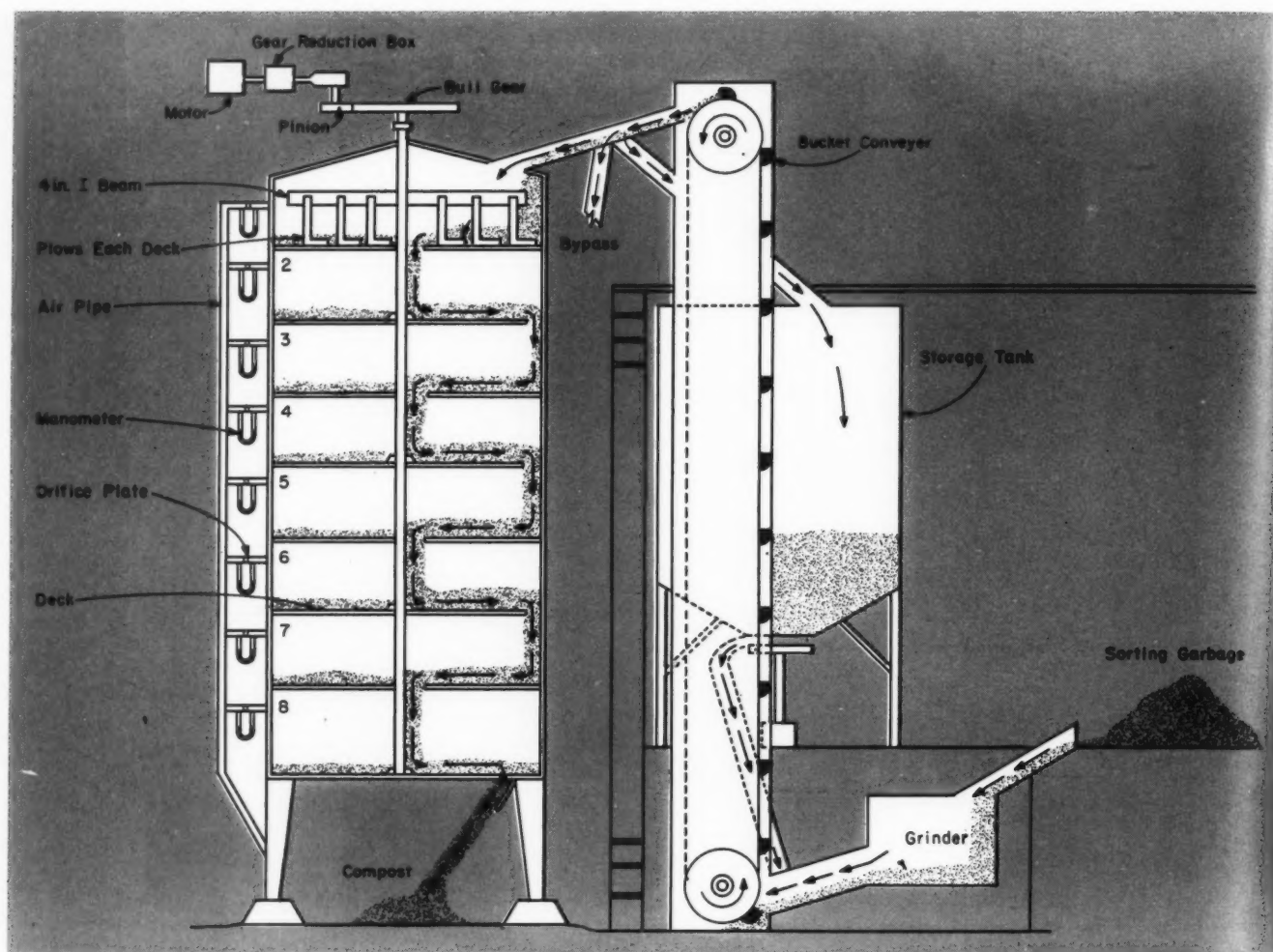
among these are high torques and poor controls. Understanding of the process is inadequate to insure prolonged successful operation. Special bacteria are claimed to be necessary for the process and these reportedly must be continually replaced.

For Municipal Composting

The process considered best adapted to municipal composting more nearly resembles that of Earp-Thomas than any other. It is a continuous flow, constantly agitated process which employs a rather high percentage of re-seeding with the end product and/or partially composted material. Its success is due to a growing understanding of the basic principles coupled with a year's experience with large scale experimentation.

College Research

Michigan State College has a laboratory composting research program built around the operation, observance, and chemical and bacteriological testing of 22 completely controlled one-pound lucite digesters. Mounted in temperature controlled water baths, the material in these gas-tight digesters is kept slowly and constantly stirred. Oxygen uptake,



SKETCH OF LARGE SCALE DIGESTER SHOWS HOW RAW GARBAGE IS TAKEN BY BUCKET CONVEYOR TO AND FROM STORAGE AND DEWATERING TANK TO THE TOP OF THE DIGESTER AND SLOWLY DROPPED DOWN THE DECKS OF THE UNIT.

carbon-dioxide production, and various other chemical yardsticks are measured.

A large scale digester stands 23 ft high, 10 ft in diameter, and is separated into eight decks. It is insulated with 2 in. foamglass. Raw ground garbage of about 55-65 percent moisture content is conveyed to the top of the digester from a storage and dewatering tank—where its initial water content was about 75-80 percent. A slowly revolving shaft turns plows that are mounted on a cross-arm on each deck. This action aerates and mixes the garbage and gradually drops it from deck to deck during the period of digestion. The depths of the composting materials vary from 4 to 12 in., depending on the adjustment of the plows. Plows have been redesigned several times with the torque reduced from an initial 20,000 ft-lbs to about half this value.

Conveyor Bottleneck

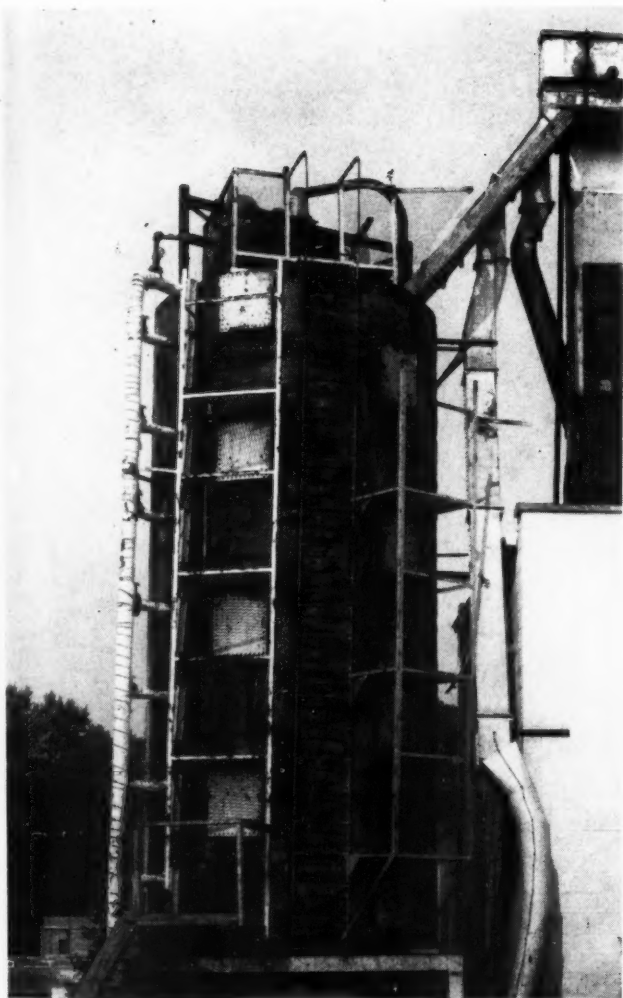
One bottleneck of this experimental unit has been the bucket conveyor. Garbage having over 75 percent moisture causes serious, if not complete clogging of the conveyor. Cleaning is aided by a 100 psi air jet at the point of discharge. Continued re-

search and development will completely resolve this difficulty in the operation of the conveyor.

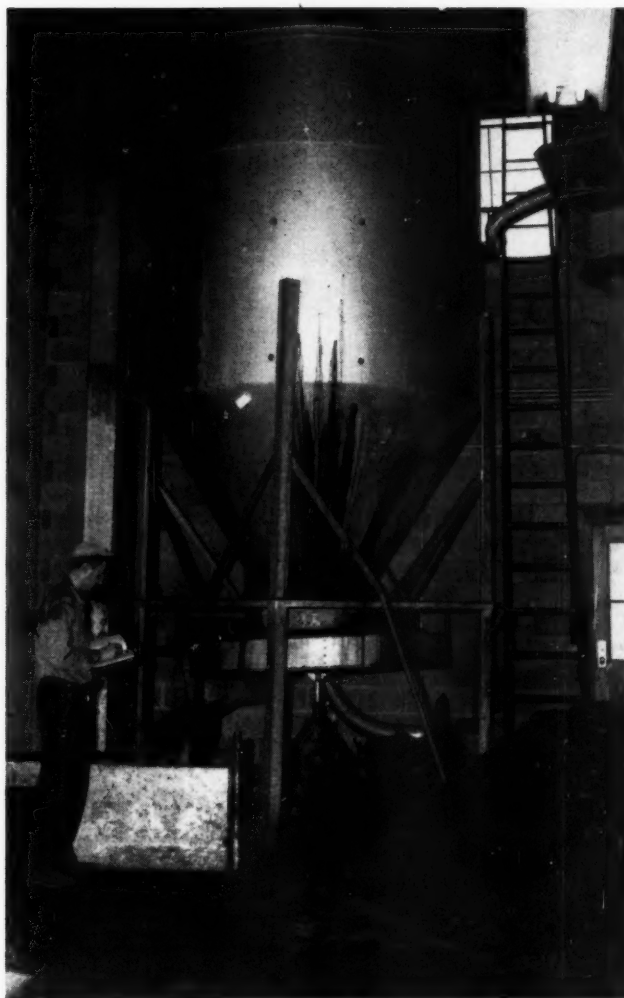
De-watering of the waste to below 75 percent moisture—and, if possible, to below 60 percent—is very desirable for good composting. Detention periods in the compostor have varied from 2 to 4 days. Based on a test run with a 3½ day detention period and the decks about 60 percent full, the digester took 4500 pounds of raw garbage daily at 60 percent moisture. The garbage, previously reduced from 75 percent moisture during storage, produced about 1200 pounds per day of end-product (at 35 percent moisture).

Seeding

Seeding was accomplished with the end-product as it entered the digester. Typical results show that the weight per cubic ft of the composting materials decreased slowly from 36 lbs on the first deck to 24 lbs on the 8th deck. The changes that occurred are indicative of a healthy high-rate composting process. No nitrogen is lost as long as aerobic conditions prevail. Further artificial drying to about 15-20 percent moisture is required before sacking



RAW GROUND GARBAGE WITH 75-80 PERCENT MOISTURE IS DEWATERED TO ABOUT 55-65 PERCENT.



A CLOSEUP OF THE DIGESTER UNIT. THE EIGHT DECK LEVELS ARE ACCESSIBLE THROUGH MANHOLES.

or bulk storage to prevent self-heating, nitrogen loss, and sack destruction. Our experimental end-product is presently used "as is" on College and City of East Lansing lawns and shrubs.

Considerable work is being conducted on studying the effects on the composting process of initial grinding of garbage, but this as yet is inconclusive. A study on the composting of sewage solids is contemplated in the near future. A companion problem which will be tackled concurrently is that of improved sludge dewatering. Laboratory work is already under way on this project.

Commercial Operation

The present experimental unit already shows ten times the efficiency of the conventional sewage sludge digestion units. A new prototype model is ready for testing. After another 18-24 months of further experimentation and improvements, it should be ready for commercial use.

The prototype model units are horizontal and can probably be constructed in sizes up to 100 tons per day without difficulty. Multiple units would be recommended for larger capacities. The time re-

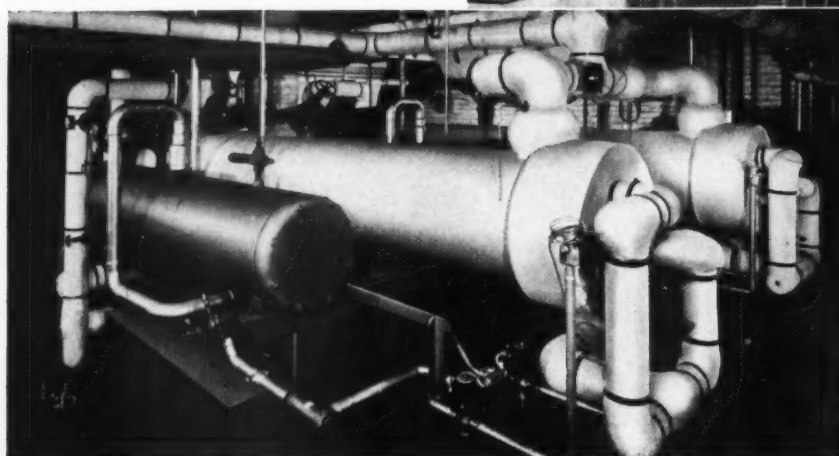
quired to reach a commercial design, with a high degree of efficiency and certainty of continued operation, will depend largely on the degree of cooperation from municipalities and other interested groups in this field. ▲ ▲

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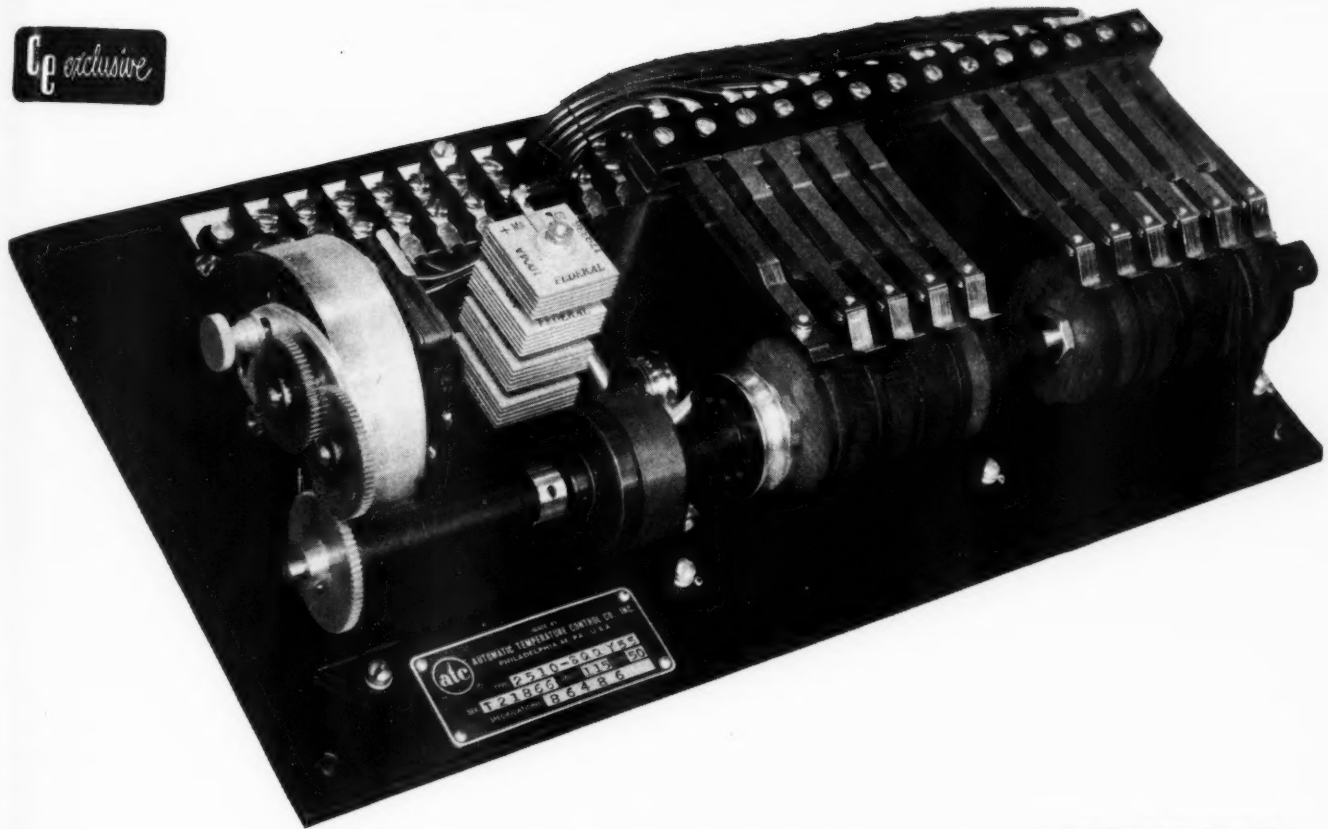
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Automatic Temperature Control Co.

THIS IS A CAM SEQUENCER OF THE RESET TYPE; IT IS DRIVEN BY A SYNCHRONOUS MOTOR. THE CAM SEQUENCER USES OPEN ELECTRICAL CONTACTS AND HAS A DIRECT-CURRENT ACTUATED CLUTCH. THERE ARE 11 CAMS.

Interlocking Control Systems

S. D. ROSS

Industrial Division (Philadelphia)

Minneapolis-Honeywell Regulator Company

INTERLOCKING CONTROL systems are usually applicable to any combination of two variables. Such systems can be extremely valuable in automatic control—either to improve the quality of control or the safety of operation.

Suppose that the reaction shown in Fig. 1 is controlled by a recording thermometer with proportional (throttling) pneumatic control. As the reaction progresses it causes the pressure to rise rapidly above its normal value; during this period, pressure must be controlled rather than temperature. For this purpose, a proportional-type pressure controller is installed in series with the temperature controller, as illustrated, so that the output air pressure of the pressure controller becomes the air supply for the temperature controller.

Operation of the system is briefly as follows: at the start of operation with pressure well below the set point of its controller, full air supply pressure is fed to the temperature controller, which functions in the normal manner to throttle its output air to the control valve. Temperature is maintained at the desired value. When the reaction causes pressure

to approach its pre-set limit, however, the pressure controller throttles its air going to the temperature controller and thus regulates the air pressure to that value required for pressure control, regardless of the output called for by the temperature controller.

By this arrangement, control is automatically taken over by one controller or the other as required by the process. Similar systems are useful for furnace temperature control when the control function must be shifted at certain times from temperature to fuel rate. Another application is air conditioning control where control must be shifted from temperature to humidity as conditions of intake air may demand. In pipeline pumping stations, either minimum suction pressure or maximum discharge pressure can be similarly interlocked to govern a single control valve by means of the series-proportional control system. Obviously, such series-connected throttling systems are more easily handled by pneumatic than by electric control.

Occasionally, it may be desirable to have one control valve respond to the average output of two controllers for different variables. This can be accomplished quite simply by connecting the two output pressures to a pneumatic relay which averages them and then transmits this average pressure to the control valve.

Another problem solved by the connection of

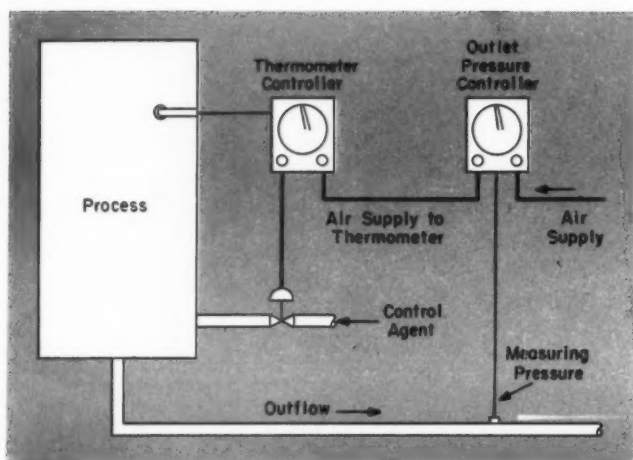


FIG. 1—SERIES PROPORTIONAL CONTROL WITH SERIES PRESSURE AND TEMPERATURE CONTROLLERS.

controllers in series is illustrated in Fig. 2. A reactor is being supplied with a controlled amount of process gas from one of two sources. Gas "A" is much cheaper than gas "B" and is therefore preferred for use in the reactor, but only if its pressure stays above 25 psi. Pressure controller PRC provides this selective use of the gases, supplying air to the flow controller (FRC-1) for gas "A" as long as the pressure of this gas is above 25 psi.

If the gas "A" pressure drops, the pressure controller cuts off air supply to FRC-1, closing the control valve. At the same time, through the action of a pneumatic relay, the pressure controller connects full air supply pressure to the flow controller (FRC-2) for gas "B", permitting its control valve to open and the flow of gas "B" to be controlled at the value set on FRC-2. As soon as the pressure of gas "A" again builds up to 25 psi, the system shuts off expensive gas "B" and again supplies gas "A"—providing sustained optimum conditions for process operation.

Cascade Control

A typical example serves to explain the basic principle of cascade control and why it can markedly improve the performance of a control system in certain cases. In the system shown in Fig. 3, assume that oil must be heated to a constant outlet temperature which cannot be permitted to vary beyond narrow limits. Characteristics of the process, however, are such that such control is not easily attained; for example, the oil passes through a long piping run in the heater so that changes in its temperature or rate of flow (which would upset the heat balance in the heater) are only detected by the outlet temperature controller after a considerable time lag—a condition recognized as one of the most difficult for a single controller to overcome.

Furthermore, assume that the pressure of the fuel gas supplying heat to the oil varies from time to

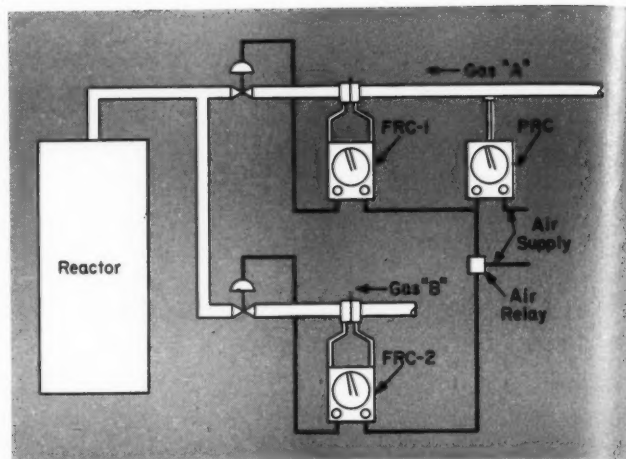


FIG. 2—SELECTIVE USE OF GAS BY SERIES CONNECTION OF PRESSURE AND 2 FLOW CONTROLLERS.

time. Because of the lag mentioned above, such changes are not immediately reflected in changes of outlet oil temperature. Thus, if a single outlet oil temperature controller were used alone to operate the control valve in the fuel line, its task would be difficult indeed. Even with the most complex form of control—automatic reset with rate response—excessive cycling of the outlet oil temperature might be expected.

Temperature and Flow

Now, suppose that a flow controller is installed on the fuel gas line and a pneumatic means is incorporated in it so that its control index can be positioned by the output air pressure of the temperature controller. Then, with a given rate of fuel flow being called for by the temperature controller, the flow controller will maintain this rate, correcting for variations in fuel gas pressure. The underlying principle here is that one controller is not expected to correct for all variations in the process which affect the controlled variable (in this case, the outlet oil temperature). The added complexity is justified by the improved over-all control.

To go one step further, if the flow rate of oil to be heated varies greatly, a flow controller might well be installed on the inlet oil line to eliminate another source of temperature variation. If it were necessary to let the inlet flow vary at will, a further refinement could be the cascading of the inlet oil flow controller with the fuel flow controller, interlocked with the temperature controller by a pneumatic relay in the output of the flow and outlet temperature controllers.

Master Controller

In contrast to ratio flow control, cascade control involves no fixed relationship between the two interlocked variables. The master (sometimes called primary) temperature controller in this example

regulates its output air pressure in accordance with whether the temperature is above or below the set-point value, just as it would if connected directly to the control valve. This output air pressure is used to raise or lower the set point of the flow controller, which in turn opens or throttles the control valve to satisfy the demands of the temperature controller. Thus, the set point of the flow controller may be at any value just as the valve position may be at any opening required to maintain the temperature at its set point.

There are many similar applications which can be found in industry or which might well be adopted to solve certain control problems. A practical example is that of a liquid level controller resetting the control index of a flow controller; in this case the flow controller immediately corrects for changes in flow due to variations in vessel pressure, thereby making the job of the liquid level controller easier. Two- and three-element boiler drum level control systems are examples of cascade control; the steam flow, and sometimes feedwater flow, is interlocked with level control in a cascade system.

Supply Changes

In general, where a process has its temperature controlled by regulation of a heating medium (such as steam, fuel gas, or fuel oil), there may be significant variations in the flow of these control agents not dictated by the temperature controller; these constitute supply changes whose effects must work through the process before being detected by the temperature controller. Whenever this involves high time lags, cascade control should be considered. Heat exchangers, furnaces, and cooling equipment may experience this condition.

One of the latest trends in process control is the use of continuous quality analyzers directly in the plant stream—such as infrared and ultraviolet spectrometers for chemical composition, viscosity meters, and the like. Methods are being explored which include such instruments as automatic controllers in cascade systems with other controllers. For example, one analyzer detecting the composition of a product in a distillation column might be used to reset the control index of a flow controller regulating steam to the column; marked improvement in product quality achieved by this closer control obviously can pay for the system in a short operating period.

Time Scheduling

There are many styles of controllers available for the control of physical process variables in accordance with a predetermined time schedule. In the heat treating of metals, for example, it is often desired to raise temperature at a fixed rate, hold at a constant value for a certain length of time, and then cool at a fixed rate—all automatically (Fig. 5).

In the operation of test chambers, it is sometimes desired to similarly vary both temperature and pressure, or temperature and humidity, with time.

Sequence Control

In some applications, it is necessary to control the sequence of operations of a process, such as opening or closing of valves, starting of pumps, and the like. Such control is broadly classed as program control; it is better differentiated as "sequence control," although there does not appear to be any standard terminology. The distinction is that sequence control does not necessarily involve a change in value of the process variable with time.

To provide automatic resetting of the control point as a function of time, two common methods are available. First, there is the use of a motor-driven, shaped cam which positions the set point directly by mechanical linkage or indirectly through a pneumatic transmission system. Secondly, there is the motor drive of the control index including means of varying the drive speed. In general, the first method is better adapted to programs which are repeated continually without change for a period of time, whereas the latter method is more flexible in setting up different programs.

Cam System

One form of cam program system employing pneumatic transmission requires at least two instruments, namely: one which translates the varying radius of the motor-driven cam into equivalent air pressures to position the set point of the second—a conventional controller equipped with a pneumatic index positioning unit. One advantage of this system is its ability to simultaneously position the set points of three or more controllers which may

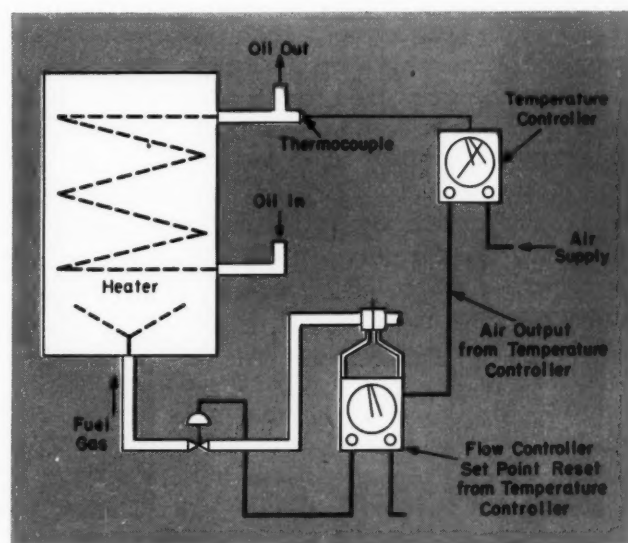


FIG. 3—CASCADE SYSTEM WITH OUTLET CONTROLLER RESETTING FLOW ON FUEL GAS LINE.

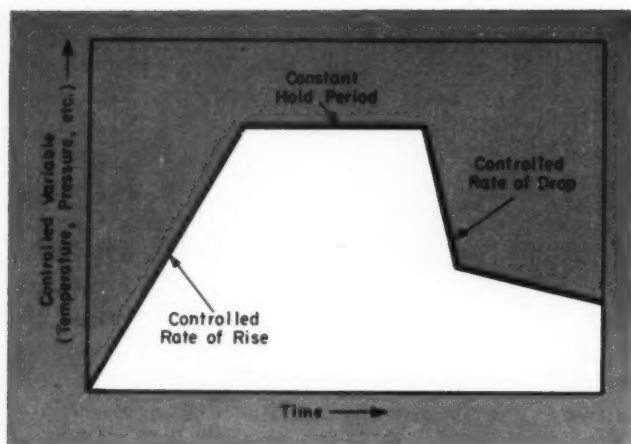


FIG. 4—PROGRAM SCHEDULE REQUIRES RESETTING OF CONTROLLER SET POINT AS FUNCTION OF TIME.

be monitoring identical processes in three or more different chambers (Fig. 5).

In addition, the cam transmitter can be incorporated in newer types of control systems employing "stack type" controllers whose set points are established by air pressure; thus, a program signal from the cam transmitter can be easily connected in the pneumatic piping carrying the set point pressure between the recorder and stack controller. The transmitter can be located as much as 600 feet from the controller.

Combinations

Another form of cam programmer has one or two integral transparent cams mounted in front of the recording chart. One model of such a controller can provide the following combinations for electric or pneumatic control:

- (1) Single measuring element with cam, separate cam drive motor, and control unit.
- (2) Single measuring element with two cams driven by same motor but with separate control unit for each cam.
- (3) Two complete sets of measuring element, cam, cam motor, and control unit in one instrument.
- (4) Same as next above, except with only one cam drive motor.

Application of the first and third items is straightforward, the main feature of the latter is its being, in effect, a two-in-one instrument. An example of the second type in use is control of size cooking, which requires program control of temperature by two separately regulated steam coils. One coil is an open, high-capacity coil to provide rapid temperature rise; the other is a low-capacity closed coil used to maintain the temperature at constant "cook" and "hold" values. With two separate cams and two separate control units to independently operate valves on the open and closed coils, it is a simple matter to cut the cam contours so that the high-capacity coil is in operation during the heating-up period and is then cut out for the cook and hold periods (Fig. 7).

Two Variables

The fourth-named type (two of everything except cam motor) is employed for independent control of two variables in a process on the same time basis. For example, temperature and pressure in a cooking retort for cans or jars of food must be controlled with a definite relationship between them. As the retort temperature is raised, its internal pressure must also be raised to prevent breakage of jars or distortion of cans. This action is easily provided by the cut pattern of two cams which are driven by

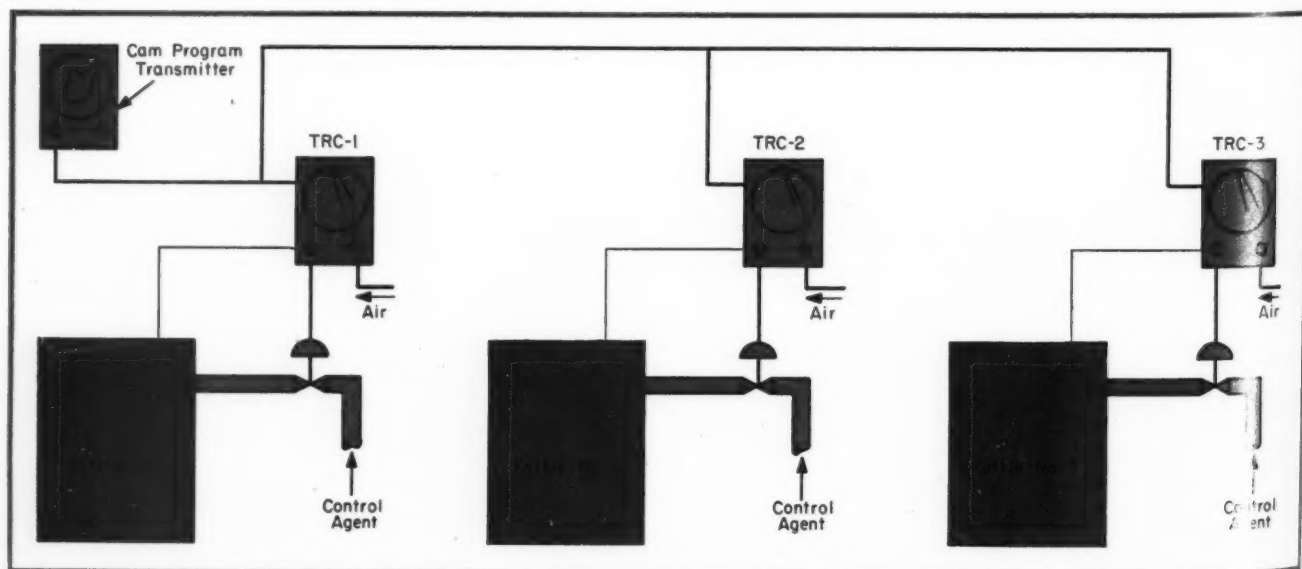


FIG. 5—IN THIS SYSTEM, THREE PROCESS VESSELS ARE EACH PROVIDED WITH INDIVIDUAL CONTROLLERS. THE CAM TRANSMITTER CONTAINS THE PROGRAM FOR ALL VESSELS AND SENDS THIS IDENTICAL PROGRAM TO

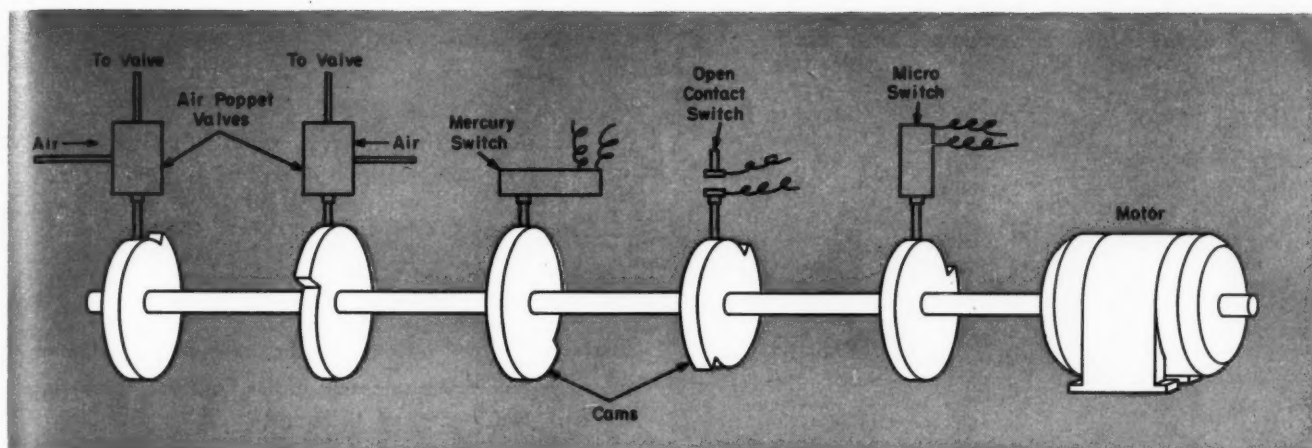


FIG. 6—A SEQUENCE CONTROLLER MAY HAVE MANY CAMS, LIMITED ONLY BY THE PHYSICAL DIMENSION OF THE DRIVING SHAFT. THIS SCHEMATIC SHOWS AN ARRANGEMENT OF MANY CAM-DRIVEN ELECTRICAL & MECHANICAL UNITS.

one drive motor, and hence monitor their respective variable set points on the same time basis.

Reversible synchronous motors or separate up-scale and downscale drive motors are used in motor-driven index program control instruments. A variety of different rates of index drive is made possible by change gears for varying the basic motor speed, combined with several different basic motor speeds. One model, for example, provides 23 different index drive speeds, from $\frac{1}{2}$ -hour to 240 hours for full-scale drive.

Almost unlimited flexibility of programming is

attained by the use of external "rate controllers" and timers. The rate controller permits speed adjustment less than the basic rate of the controller; it interrupts the motor circuit periodically at frequent enough intervals that, in effect, continuous index drive at a reduced rate is obtained. Timers, actuated by index-operated switches, are used to control the length of "hold" periods during which the controller index remains stationary. Several sets of auxiliary switches, both pen-operated and index-operated, permit the design of an almost endless variety of programs with supplementary alarm signals and with coordinated operation of accessory control apparatus.

Sequence Control

On-off operation of control valves, pumps, agitators, alarms, and the like can be provided by a motor-driven shaft carrying cams for each operation which is to be started or stopped in sequence. As shown schematically in Fig. 6, the rotating cams are shaped to open or close air poppet valves or electric switches, each of which may initiate the action of one or more control devices. By addition of auxiliary pneumatic or electric relays for "holding in" or "locking out" devices in the system, an endless variety of sequence control arrangements can be devised.

Other styles of sequence control devices have been developed to meet process requirements. Operation of large numbers of valves for a great many operations, need for finer settings and frequently adjusted settings, and other factors have led to a variety of such controls.

Combinations of such sequence control and automatic control of the variables of a process—initiated by a push-button or switch—can often eliminate manual operation entirely. The operator is freed of the tedious, constant watch over the process. In addition, an exact and nearly perfectly repeated cycles of operation come into existence. ▲ ▲

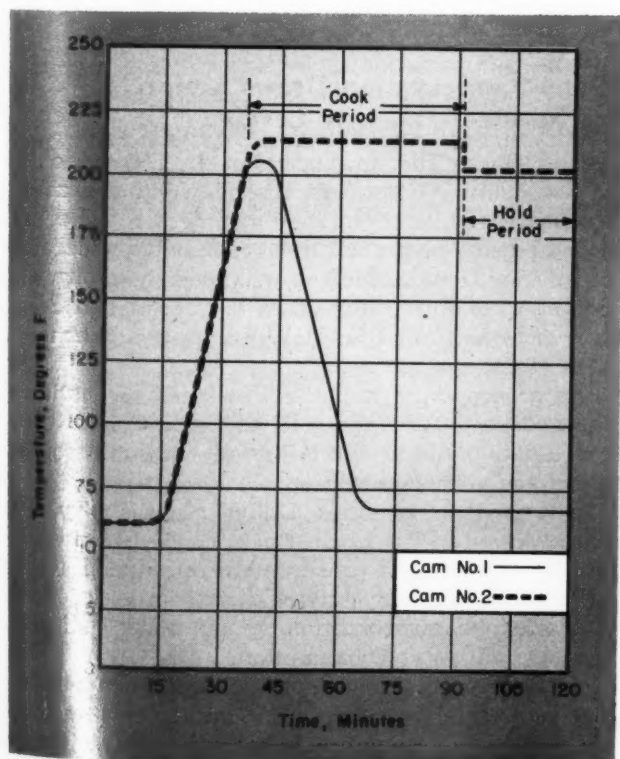
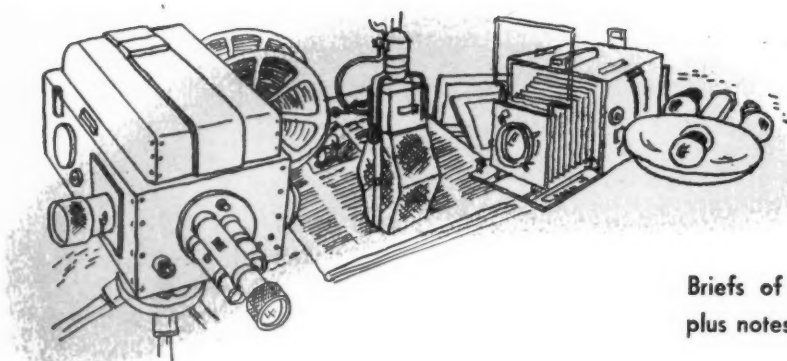


FIG. 7—THIS COOKING CYCLE USES A CAM PROGRAMMER WITH TWO CAMS PLUS CONTROL UNITS.



NEWS

Briefs of current interest to the consulting profession plus notes on new equipment in the field of engineering



TRIPOD IN THE SKY

Perched atop Mt. Washington opposite Point Park and overlooking Pittsburgh, engineers of the State Highway Dept. have erected a steel tower 77 ft high to speed up measurements for the new Fort Pitt Bridge and Fort Pitt Tunnels which will cross the Monongahela River. Erecting the tower saved weeks of work by surveying teams that would have had to hike with transit and chain over the rugged terrain. The surveying tower was also used on engineering the Squirrel Hill Tunnels.

Asphalt and Rubber Road Topping Can Be Mixed at Asphalt Plants

Tiny pellets no bigger than pencil erasers may break the bottleneck that has prevented the widespread use of rubber roads.

Developed by the Naugatuck Chemical Division, United States Rubber Co., the pellets make every asphalt plant in the country a potential rubber-road mix plant. Tossed into a mixing mill at an asphalt plant, they break down in 60 sec, spreading rubber evenly through the mix.

Previously, asphalt and rubber were premixed at the chemical plant and the hot mixture shipped

in insulated tank cars or trucks to the construction site. This system meant high transportation costs, and also limited the shipping range to a 24-hr trip from the plant.

From 6 to 12 lb of the synthetic rubber pellets are added to a ton of asphalt, which covers 13 sq yd of previously paved road with a one-and-a-half inch thick layer. This amount of pellets gives a three to six percent rubber content, and costs are about a third below the cost of Naugatuck Chemical's previous material.

Rubber-asphalt topping increases the load-carrying capacity of the road and improves skid resistance by preventing asphalt oil from rising to the surface and causing a slickcoating after a light rain. The rubber also improves the bond between the asphalt and stone aggregate, preventing the stone from being stripped away by fast-moving cars.

Water Conservation Draws Action on National and City Levels

Underlining the seriousness of the water problem in this country, President Eisenhower has named a committee of three cabinet members for the purpose of developing a natural water policy. Secretary of Interior Douglas McKay will head the group with Secretary of Agriculture Ezra T. Benson, and Secretary of Defense Charles E. Wilson as the other members of the committee.

As a secondary step the President reconstituted the Federal Inter-Agency River Basin Committee to coordinate federal activities in water resources work and soil conservation.

Six major U. S. cities, Dallas, Kansas City, Chicago, Atlanta, and Little Rock, concerned with increasing per capita consumption of water, have instituted a two-year study of their own to determine the effect of air conditioning and lawn sprinkling systems on water consumption.

In Dallas last summer, on the days when rain fell, consumption dropped from 118 million gal per day to 60 million—a saving of 58 million gal. Dallas City Water Superintendent Carl Hoefle attributed the drop to the fact that there was no lawn sprinkling and that air conditioners, especially the evaporative

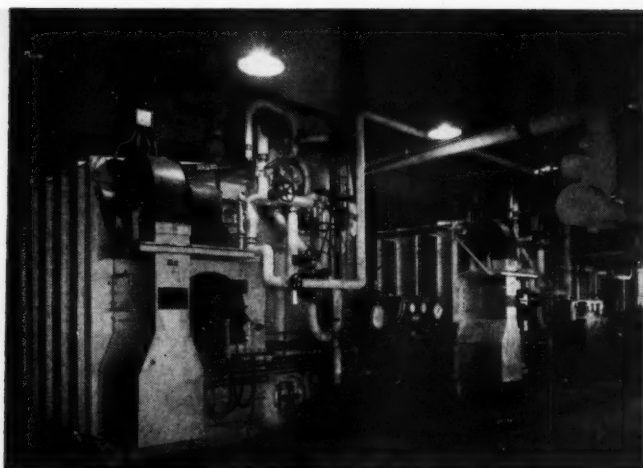
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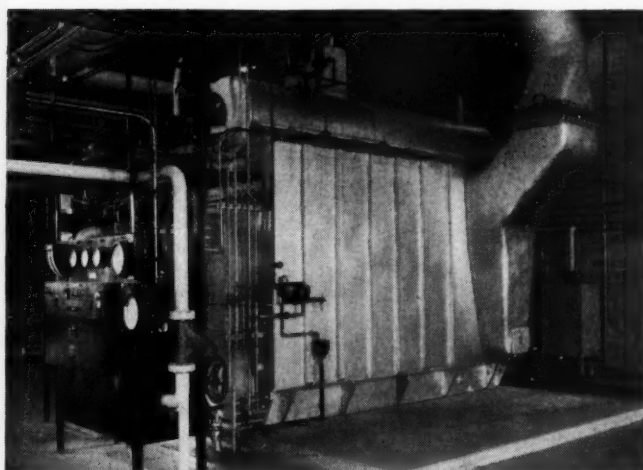
Little wonder then that VP purchasers range from small companies to some of the largest in the country . . . industrials of all kinds . . . schools and institutions . . . various government agencies . . . even the Atomic Energy Commission. These users are employing VP Boilers for all types of applications — heating, process, and even power generation.

Make sure then that you have details of the VP at your fingertips when next you are in the market for a boiler of moderate capacity. Ask for the new Catalog VP-254, which contains specifications and general information on dimensions, space requirements, construction details and controls.

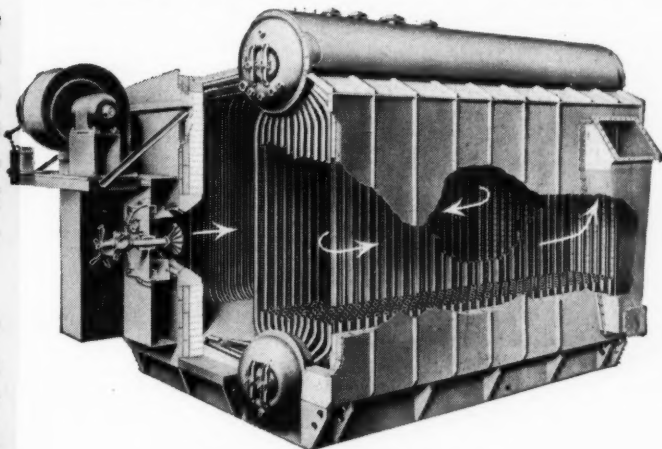
B-7488



Industrial installation in the Midwest. Two VP Boilers.
Capacity — 28,000 lb steam per hr each at 225 psi.



This VP Boiler serves a sewer pipe manufacturer in California. Capacity — 20,000 lb steam per hr at 215 psi.



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Pressures—Up to 500 pounds per square inch
Fuel—Oil or gas
Erection—Completely shop-assembled
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COMBUSTION ENGINEERING

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

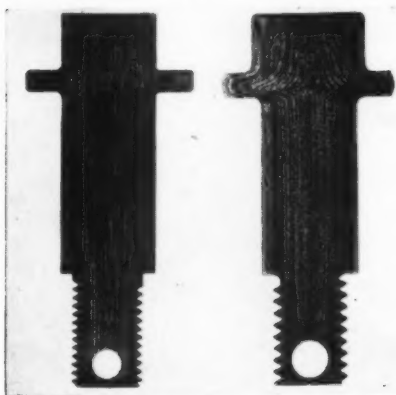
BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

Water Conservation Draws Action

—Starts on page 60

coolers which do not function in highly humid weather, were shut down. The cities will attempt to determine the amount of water consumption attributable to each use and what can be done to control the situation.

Cold-Forming Increases Surface Hardness



The extent to which modern cold-forming techniques permit severe displacement of metal without fracturing or interrupting grain structure is shown at right. The part, made from steel wire, was acid-etched

to show grain lines, then photographed at 3.5 x linear enlargement. This forming method is said to retain maximum strength in both tension and shear, in contrast to the machined part at left, where, particularly in the threaded section, weakness is introduced by cutting the grain structure sharply.

The photograph at the right clearly shows compression of the outer fibers, indicating the increased surface hardness which is a natural characteristic of parts formed by Cold-Flow, a process developed by Camcar Screw & Mfg. Corp.

To illustrate the advantages of this forming method, Camcar will send a sample box, free of charge, containing two brass parts: a terminal post and a contact point. Address the Company at 604 18th Ave., Rockford, Ill.

Construction Spending May Reach \$36 Billion This Year

It is now evident to the most skeptical that there is a building boom in progress. The first five months of the year's expenditures for construction were above those of 1953. This pattern has followed through every month of the year. There is strong evidence that the general picture for the building industry will continue to be bright especially in the construction of office buildings, shopping and service buildings, schools, and churches, according to the Smith, Hinchman & Grylls, Inc. monthly building cost report. The report forecasts an estimated total of \$36 billion will be spent on construction in 1954.

Steel production is showing signs of a slight rise in rate since last month. The rate is now about 73 percent of capacity, and there is apparently an end

to the declining rate of the last eight months or more. Costs of highway construction are considerably lower than last year and the building industry has been showing no scarcity in the number of bidders on each project.

Appointment of Engineer Urged for St. Lawrence Seaway Development Corp.

Mindful of the omission of engineers in the appointments of principals to the United States Section of the St. Lawrence River Joint Board of Engineers, Engineers Joint Council is taking the stand that the interests of the nation require the inclusion of at least one engineer in the forthcoming appointments to the five-member Advisory Board of the St. Lawrence Seaway Development Corp. This Advisory Board will review policies in connection with design and construction of the development, which will encompass engineering works of immense magnitude and tremendous costs.

Through its National Engineers Committee, EJC had protested appointments, as principals, two non-engineers to the Joint Board of Engineers: the Secretary of the Army and the Chairman of the Federal Power Commission. The Board is composed of four principals; two from the United States and two from Canada. Of these four men, only one is an engineer and he is a Canadian.

Unit Heaters Available in Vertical and Horizontal Types

Attractively and functionally designed, this completely redesigned line of unit heaters is for steam or hot water operation.

The heaters are built in both horizontal and vertical types (see illustration) in a wide range of sizes for any industrial or commercial application. They operate quietly and are tested and rated in accordance with the Standard Test Codes adopted jointly by the Industrial Unit Association and the American Society of Heating and Ventilating Engineers.

Descriptive literature will be sent upon request to American Blower Corp., Detroit 32, Mich.



New Purchase Policy Announced for Turbo-Generating Equipment

Aimed at leveling out the customary "peaks and valleys" in the ordering of heavy power-generating equipment, General Electric's Turbine Division has



single or multiple* installations

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CONTROL SYSTEMS

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Purchase Policy Announced

—Starts on page 62

announced a new policy designed to stimulate orderly purchase of such equipment, ease the financing process, and maintain optimum employment and use of engineering and manufacturing facilities.

Under this new plan G. E. will undertake initial engineering and manufacturing work on large equipment orders with the provision that such orders may be cancelled up to six months later at a minimum amount of the contract price. This "cancellation charge," according to G. B. Warren, vice president and general manager of the Division, would be much less than the normal customer liability and less than the actual factory cost incurred.

In the case of early shipment orders, cancellation will be required 12 months in advance of the scheduled delivery date.

In addition, G. E. will endeavor to work out a means of financing charges normally made prior to shipment until financing of the new equipment can be handled by the customer.

Abbett to Review Handbook At September AICE Meeting

"Civil Engineering Handbook," a new issue in three volumes being prepared under direction of Robert W. Abbett, Partner, Knappen-Tippetts-Abbett-McCarthy, Engineers, will be discussed by Mr. Abbett at the September 1st luncheon meeting of the American Institute of Consulting Engineers. The meeting will be held at the Engineers' Club, 32 West 40th St., New York City, at 12:30 P. M.

Bid Specifications Discriminatory, Says Manufacturer

Brown Boveri Corp. of New York, last year's low bidder on the turbo-generator sets required by the City of Detroit whose bid subsequently resulted in

a prolonged discussion and an official decision to ask for new bids, has refrained from tendering a proposal on the new bid invitations which closed June 8th because of certain clauses in the specifications, according to a statement issued by Paul R. Sidler, president of Brown Boveri.

The present request for bids, according to Mr. Sidler, contains specific clauses which are highly prejudicial to his company, in opposition to the Administration's present policy of encouraging free trade, and contrary to the best interest of Detroit business and industry.

"We are a reputable manufacturer of power generating equipment such as the City of Detroit proposes using. Yet, we are asked to furnish a surety bond of five years duration to compensate the City against operating failures, losses in revenue, and other similar secondary damages because, as the clause is written, Brown Boveri Corp. of New York is not the manufacturer of the equipment but merely the New York sales and engineering branch of the parent Swiss company.

"The posting of a five year surety bond works no particular hardship on my company. Yet, on general principles, it refuses to do so when other bidders merely give their customary guarantee without a bond. This surety bond, I believe, is a discriminatory provision. It smacks of favoritism. Furthermore, the entire situation has all the earmarks of using Brown Boveri to apply pressure on American manufacturers. We would not submit an offer to supply the City of Detroit the power generating equipment on such a basis."

NSPE Works Toward Professionalism of Engineers

"It is for the engineer, rather than the employer, to determine when and how the employer should be notified of an impending shift in employment," according to a resolution passed by the National Society of Professional Engineers at the annual June meeting.

This resolution, submitted by the Delaware Society, is an attempt to countermand the so-called "gentlemen's agreements" whereby potential employers will not consider for employment engineers working in the same general field or geographic area until the engineer has severed all connections with his present employer.

However, the Society adopted the resolution with the reservation that it was the responsibility of the engineer to inform his employer of his intentions, so long as such an act would not jeopardize the employee's status or future with the immediate employer.

NSPE feels that such agreements "deprive the engineer of the right to seek employment in an attempt to better himself, without jeopardizing his immediate position."

At the same meeting, NSPE adopted a program of closer cooperation with the American Institute of Architects and also with architects on the state and local level.



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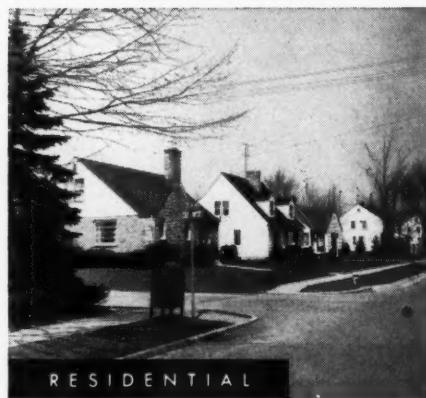
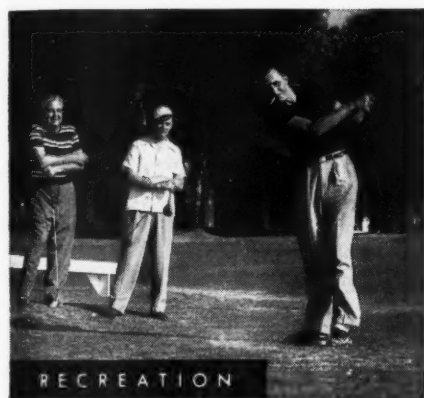
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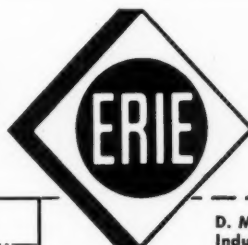
Many of these middle-sized towns in the Erie Area meet the requirements of the Government's Dispersal Plan for industry.

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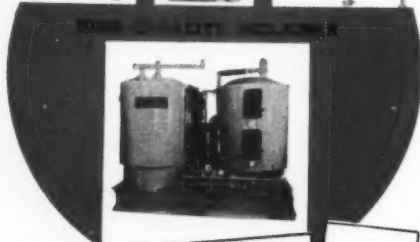
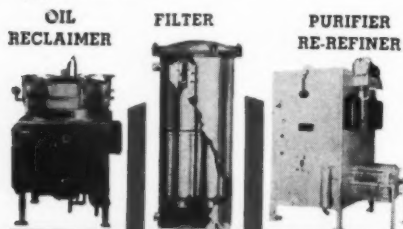


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MEN

IN ENGINEERING

★ Four companies have combined resources to form U. S. Industrial Engineers & Constructors in New Orleans, La.: R. P. Farnsworth & Co., Inc.; James F. O'Neil Co.; Walter J. Barnes Electric Co.; and de Laureal & Moses, Consulting Engineers.

★ President of the American Institute of Electrical Engineers is A. C. Monteith, vice president in charge of engineering and research, Westinghouse Electric Corp. He succeeds Elgin E. Robertson. Vice presidents are: G. J. Crowdes, Simplex Wire & Cable Co.; J. P. Newbauer, Consolidated Edison Co.; Claude M. Summers, General Electric Co.; S. M. Sharp, Southwestern Gas & Electric Co.; and John R. Walker, U. S. Bureau of Reclamation. Walter J. Barrett, New Jersey Bell Telephone, is re-elected treasurer for one year.

★ I-T-E Circuit Breaker Co. announces that through an exchange of common stock BullDog Electric Products Co. has become a subsidiary of I-T-E. William H. Frank remains as president of BullDog and he and Henry B. Frank will join the board of directors of I-T-E.

★ Nominees for offices in the American Society of Mechanical Engineers for 1955 are: President, David W. R. Morgan, Westinghouse Electric Co.; vice-presidents, James B. Jones of Virginia Polytechnic Institute, Ben G. Elliott of the University of

Wisconsin, C. H. Shumaker of Southern Methodist University, and William H. Byrne of Byrne Associates, Inc. and Stevens and Wood, Inc. Nominated as directors-at-large are: Louis F. Polk, Sheffield Corp., Dayton; George A. Hawkins, Purdue University; and Harold C. R. Carlson, The Carlson Co., New York.

★ The H. K. Ferguson Co. announces formation of a new British company to be known as H. K. Ferguson Co. of Great Britain, Ltd., with headquarters at 19 Berkeley St., London, England. Charles P. Stolberg will direct engineering and construction, and Raymond B. Aufmuth will be chief engineer with headquarters in London.

★ Arnold H. Vollmer becomes a general partner of Brown & Blauvelt, consulting engineers, and a general partner of Brown, Blauvelt & Leonard, an affiliated firm in the chemical and industrial engineering field.

★ F. H. McGraw & Co., currently building the \$1 million uranium separation plant for the Atomic Energy Commission at Paducah, Kentucky, this week marks its 25th anniversary.

★ Daniel Mapes, vice president of Walter Kidde and Co., will be one of three leaders of industry and engineering to receive the honorary degree of Doctor of Engineering at Stevens Institute of Technology.

HOLD THAT TIGER

Kneeling beside his prize catch, a 10-1/2 ft Royal Bengal Tiger, H. H. Levonian, vp in charge of construction for The Kuljian Corp., is shown at a big game hunt shortly before his return to the States after spending almost three years supervising construction of the Bokaro Power Station in India.





FEWER SPLICES need be made when you run "all purpose" Durasheath. It can be run buried, overhead, in ducts . . . in one continuous run.

New trend in industrial wiring: Neoprene jacketed cable

Users find this tough, long-lasting "premium" cable actually costs little more to use . . . then cuts upkeep.

A chemical plant in Texas uses ANACONDA Durasheath* neoprene jacketed cable as building wire for power and lighting. A plant in St. Louis does, too. Another in Chicago.

The practice of using versatile Durasheath for building wire has caught on from coast to coast. And there's good reason.

This cable costs little more to use than the cheapest cable you can buy—

and more than makes up this difference in long trouble-free service, lower maintenance costs!

Durasheath's tough jacket is made of specially compounded neoprene. It shrugs off heat, moisture, corrosive fumes. And it takes rough handling in stride. As demand for electricity rises, Durasheath provides added reliability.

Industry engineers call Durasheath "good insurance." And it is!

Durasheath comes in all sizes, single and multiple conductor, copper and aluminum from 600 to 15,000 volts. You can run it in the ground, overhead, in damp ducts in *one continuous run* with minimum splicing. Want more information? See your Anaconda Representative or write *Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.*

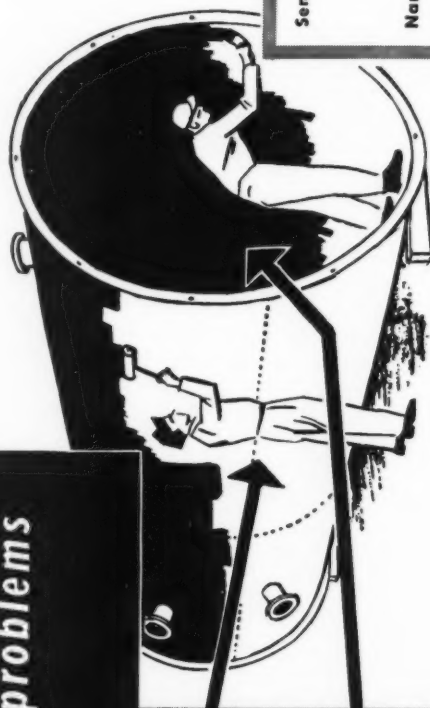
*Reg. U. S. Pat. Off. 54387

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Maintenance Coating Protects against ALL FUMES

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Heavy duty Liquid Lining means peak IMMERSION SERVICE

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MEN

—Starts on page 66

Vice Admiral Edward L. Cochrane (U.S.N. retired), now vice president of Massachusetts Institute of Technology, and Morse G. Dial, president of Union Carbide and Carbon Corp., will also receive honorary degrees.

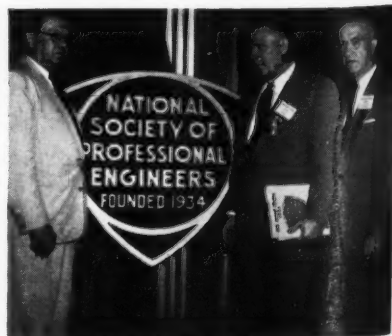
★ Franklin J. Leerburger, chief consulting engineer of the Power Authority of the State of New York, has resigned his position. It is expected that he will continue to serve the Authority, from time to time in a consulting capacity on specific, important problems.

★ The Catholic University of America has conferred the honorary degree of Doctor of Science on William F. Ryan, vice president and senior consulting engineer of Stone & Webster Engineering Corp., in recognition of his "distinguished services in the field of engineering, with particular reference to the spiritual and moral aspects of the profession."

★ Stephen F. Learnard, formerly in the chemical and engineering dept. of M.I.T., joins the staff of Arthur D. Little, Inc.

★ Michael Baker, Jr., Inc., has appointed Sam P. Turnbull as Project Manager for the firm's offices at College Park, Maryland. Turnbull was formerly chief engineer for the Florida State Road Dept.

★ Carl A. Maxwell joins the Lummus Company as a power plant consultant. He was formerly associated with Babcock & Wilcox Co.



ENGINEERS DISCUSS PROBLEMS

Discussing problems of the profession at the 20th Annual Meeting of the National Society of Professional Engineers are, left to right: Fred Hendrick, sec'y of Michigan Society of Professional Engineers, Michigan Public Service Commission; Wesley Bintz, president of MSPE, consultant; James H. Foote, national director, NSPE, Commonwealth Association, Inc.

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Engineering!

Building any kind of a heat enclosure?

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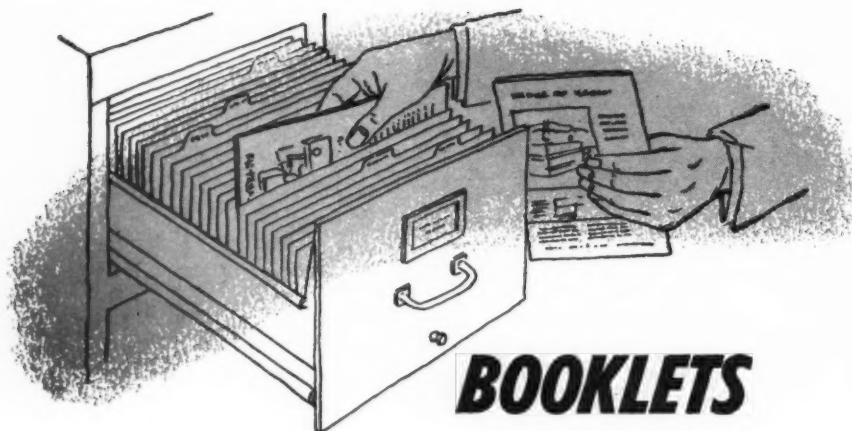
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Personal copies of booklets can be obtained by writing directly to the manufacturers

CUPOLA DUST CONTROL SYSTEMS, such as washing, dry suction cyclone, combination gas conditioner, and suction bag are dealt with in seven-page bulletin 3. A simplified and economical approach to the problem of collecting cupola dust "dry" is then presented. *Mechanical Industries, Inc., Dept. CE, 949 Grogan Building, Pittsburgh 22, Pa.*

How, WHY, AND WHEN to use gas-fired unit heaters is outlined in pocket-size 20-page bulletin SA-

541-A. Included are hints on heater selection and installation, a schematic diagram explaining how such units work, heating survey outline, instructions for estimating heat loss, and for computing gas line requirements. *Reznor Manufacturing Co., Dept. CE, Mercer, Pa.*

ELECTRONIC REGULATOR—Two-page bulletin K-2076 explains the function of a newly developed electronic regulator in controlling motor or generator field excitation. It de-

scribes ease of maintenance afforded by Sealpak Unit electronic circuit and summarizes features, functions, and typical application on this VSR regulator. *Reliance Electric and Engineering Co., Dept. CE, 1076 Ivanhoe Road, Cleveland 10, Ohio.*

SCALE MODELS—A pioneer in the development of engineering models is offering this booklet showing its facilities for producing scale models of process plants, laboratories, plant layouts, and industrial products. *Industrial Models, Inc., Dept. CE, 2311 Sconset Road, Wilmington 3, Del.*

HYDRAULIC AND PNEUMATIC CONTROLS—Pressure switch selection has been put into plain, understandable terms in a selection chart based on specific requirements in 33-page booklet 4G. Data in this book includes detailed description and illustration of the Shear-Seal principle and its application in manual and solenoid valves. *Barksdale Valves, Dept. CE, 5125 Alcoa Ave., Los Angeles 58, Calif.*

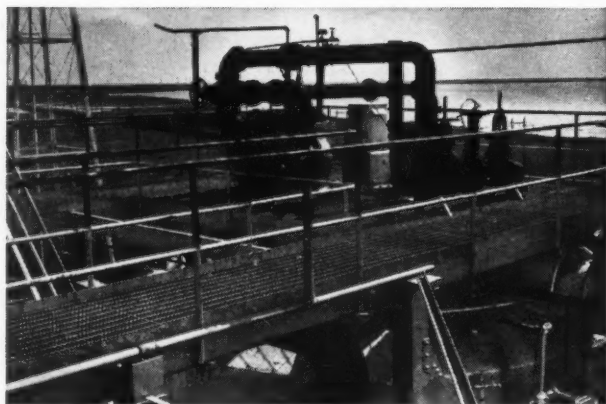
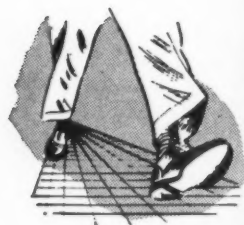


MOTOR PULLEYS—Complete redesign of the standard line of this company's Vari-Speed motor pulleys is described in 28-page catalog V-545. Lubrication, controls available, instruction on how to select the proper unit, complete rating tables, and dimensional diagrams are included. *Reeves Pulley Co., Dept. CE, Columbus, Ind.*

STEAM CONDENSERS—Design and engineering features of many types of condensers—conventional, single elbow, and twin inlet—along with sketches showing the many features of this company's multi-steam path condensers are given in 21-page bulletin 19B7987. Also described are backwash systems and air removal equipment. *Allis-Chalmers Mfg. Co., Dept. CE, 943 S. 70th St., Milwaukee, Wis.*

PACKAGED AUTOMATIC BOILERS—Two types of Powermaster boilers in 17 sizes from 15 through 500 hp for steam processing as well as steam and hot water heating service as applied to hospitals—both replacement and new construction—are described in four-page folder 1223. Bulletin compares advantages of

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Sturdy, one-piece construction with tops of all bars flush provides open steel flooring and stairs for safe, easier walking. Gary Grating is furnished in a wide variety of neat appearing designs and sizes—and is tailor-made to fit your needs. For complete description and installation pictures on Gary Welded Grating, Stair Treads and Gary-Irving Decking, ask for Catalog CE-84

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THE ROOF of the new Walnut Grove School, West Mifflin Borough, Allegheny County, Pa., is USS Stainless Steel. Architects: Button and McLean, Pittsburgh, Pa. Contractor: Nicholas LeDonne, Clairton, Pa. Roofing contractor: Limbach Company, Pittsburgh.

New Walnut Grove School has a maintenance-free roof of Stainless Steel

•The school board of West Mifflin Borough, Allegheny County, Pennsylvania, took care of roof maintenance almost permanently when the new Walnut Grove School was built. They did it by specifying a roof of long-lasting USS Stainless Steel.

The roof is approximately 385 feet long and 75 feet wide. The Stainless Steel roofing panels have a satin-type architectural finish. They are of 26-gage material fabricated into a standing seam panel 27 $\frac{3}{8}$ " wide by 12 feet long.

Stainless Steel's superior corrosion resistance, combined with its almost complete freedom from maintenance, fits it for years and years of satisfactory service. It has excellent reflective properties, and features needed strength with light weight.

The Stainless Steel roofing sheets are laid on double-coated, 35 pound asbestos felt. Each cross seam is caulked and the roofing is locked into the Stainless Steel gutter. Gutters and downspouts are of 22-gage Stainless Steel, architectural finish.

In addition, all attachments, supports, hanger bars, bolts and screws are Stainless Steel.

Stainless Steel is finding wide favor with school architects, not only for roofing, but for exterior walls as well, when used in the form of insulated panels. Of course, its wonderful possibilities for interior trim are also being used to advantage.

If you have a new school in the planning stage, now is the time to think in terms of Stainless Steel and its many benefits. And think in terms of perfected, service-tested USS Stainless Steel. For more information, mail the coupon below. If you like, we will be pleased to have one of our representatives call.



INSTALLING the standing-seam USS Stainless Steel roof on the new Walnut Grove School. The roof was laid on double-coated asbestos felt with each cross seam carefully caulked before the upper sheet was installed.

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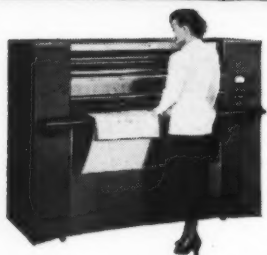
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Model 14: Another desk-side copying machine, but one which operates on standard 115 volt alternating current.

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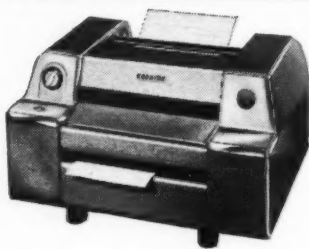
Model 30: Designed for drafting rooms with medium copying requirements and a modest budget for equipment.



Model 11: Consists of a printer, a developer, and a combination stand—each unit may be purchased separately if desired.



Model 20: A low-cost, standard 46-inch printing width machine which operates on regular 115 volt A. C. electrical circuit.



Model 100: An all-purpose desk-top copying machine with 11-inch printing width. Operates at 12 feet per minute.

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Copies anything typed, written, printed or drawn on ordinary translucent paper—in seconds.

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BOOKLETS —Starts on page 70

these boilers with equipment of conventional design. *Orr & Sembower, Inc., Dept. CE, Morgantown Road, Reading, Pa.*

SYNTHETIC RESIN COATINGS—Eight-page bulletin stresses the importance of intelligent cooperation between the manufacturer, applicator, and the man who writes the specifications for getting the best results using these coatings. Illustrations show coating applications to storage tanks in the shipping, petroleum, pickling, and chemical industries. *Metalweld, Inc., Dept. CE, Scotts Lane & Abbottsford Ave., Phila. 29, Pa.*

STEEL BOILER RATINGS—"A report to those concerned with the specification, selection, and sale of Steel Firetube Boilers," gives complete information on the Kewanee Reserve Plus Rating Plan designed to correct the confusion caused by the variance in the presentation of data on boiler ratings. *Kewanee-Ross Corp., Dept. CE, Kewanee, Ill.*

"PNEUMATIC OPERATED CONTROL," seven-page booklet 5421, should be of special interest to consulting engineers in the field of water and waste treatment. It describes the five basic elements of the P.O.C. System and explains how the elements are combined to accomplish all of the various types of process measurement and control. *General Filter Company, Dept. CE, 923 Second St., Ames, Iowa.*

PROPER REGULATION OF AIR in the firing of ceramic products is described in "Industrial Gas Analysis in Tunnel Kilns," bulletin AD-611. Advantages of continuous oxygen measurement for process regulation are explained. *Arnold O. Beckman, Inc., Dept. CE, 1020 Mission St., South Pasadena, Calif.*

"INDUSTRIAL OPPORTUNITIES IN KANSAS," 25 pages, is a survey by Midwest Research Institute describing new opportunities within the state for manufacturers seeking near-to-market locations. The report also stresses five fields of consumer products with particularly outstanding market potentials. *Kansas Ind. Development Commission, Dept. CE, 1025 Kansas Ave., Topeka, Kansas.*

WHERE AND HOW TO INSTALL five types of timber connectors, used to increase the strength of joints in a wide variety of light and heavy timber structures, are described in the new edition of the 12-page booklet, "Installing TECO Timber Con-

CONSULTING ENGINEER

nectors." Connectors described include wedge-fit split rings used in trussed rafters and heavier timber roof trusses and shear plates for joining wood to steel and for demountable wood-to-wood connection. *Timber Engineering Co., Dept. CE, 1319 18th St., N. W., Washington 6, D. C.*

PROJECT SERVICES—This comprehensive booklet indicates in words and pictures the engineering, consulting, and constructing services offered in the continental United States and throughout the world by this company. Photographs show projects completed. *Gilbert Associates, Inc., Dept. CE-PR, Reading, Pa.*

MUDLINE VALVE—Four-page folder 12-S points out the outstanding construction features for extra long service life and low maintenance of the 2000 psi WP and 3000 psi WP alloy steel mud valves. Interchangeability of parts is stressed along with simplicity of operation. *Edward Valves, Inc., Subsidiary of Rockwell Mfg. Co., Dept. CE, 1201 West 145 St., East Chicago, Ind.*



CUSTOM ENGINEERED EQUIPMENT for petroleum refineries, chemical plants, and power plants are pictured in use in these industries in 12-page bulletin E-1. Included in this line of equipment are stills and towers, heat exchangers, reactors, oil chillers, crystallizers, steam generators, and ice making and refrigerating machinery. *Henry Vogt Machine Co., Dept. CE, Louisville 10, Ky.*

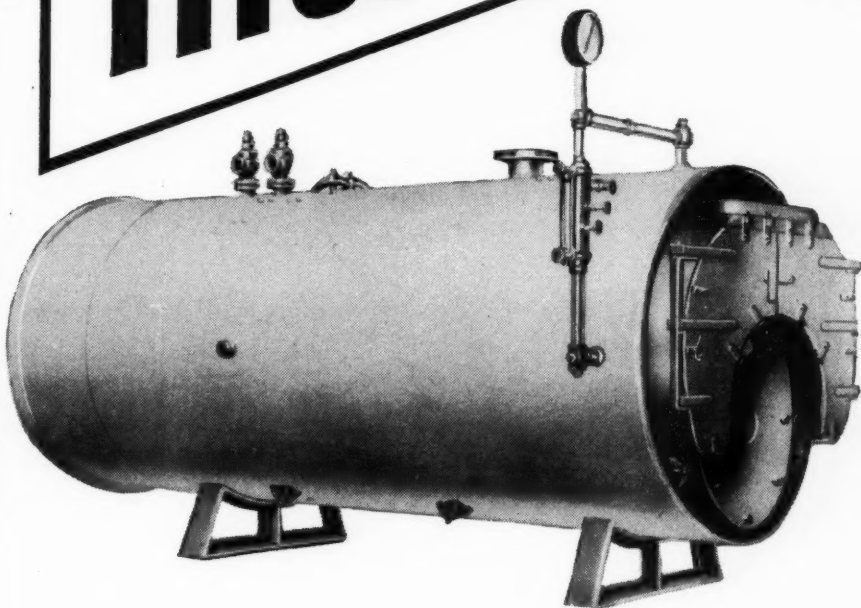
SCALE MODELS, their application and manufacture, are described in four-page folder K. It pictures a number of models produced in metal, wood, and plastic—ranging from broad stylized work to finely detailed constructions—for a number of clients. *Arthur B. Johnson & Co., Inc., Dept. CE, 392 East 201 St., N. Y. 28, N. Y.*

COLD CATHODE INDUSTRIAL LIGHTING is explained in a non-technical manner in two four-page folders. Photographs show applications of this type of lighting in units and in rows for school, commercial, and industrial illumination. *Celine, Inc., Dept. CE, St. Charles, Ill.*

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Coal Microscopy

— Starts on page 32

present as particles. Coal dust is a problem almost wherever coal is used, industrially or domestically. It is frequently a health hazard in mines and can also be a safety problem because of its explosiveness. Microscopic study provides identification of the components that have produced the dust, and these data often can be applied to solve the problem.

Geologic Applications

Study of the microfossil content of a coal bed is important in the characterization of the bed for future identification. Considerable research is being done in this phase of coal microscopy in the United States today, mostly by State and Federal geological surveys. Coal petrography (study of the whole structure of coal) also can be employed in identifying coal beds. Ideally, both research on microfossils and on petrography should be used for this purpose.

Identification is especially important where there are many beds, as is true in most American coal fields. Rapid microscopic determinations on a sample from a bed of doubtful identity may prove very useful in coal prospecting, because much chemical and other information may be available on the same coal bed, as mined in another location. Then the work of obtaining this hard earned information need not be repeated if the bed can be identified with certainty. Identification of a coal bed can also be important in mining practice to establish the sequence of beds, both coal and rock, in the mine.

Legal Applications

One rather interesting way in which coal microscopy can be useful is in making positive identification of certain fragments of coal for legal purposes. A coal microscopist often can easily tell whether a commercially delivered coal is what it is represented to be or if it is a blend of different coals. This is of value because a blend may give a total chemical analysis similar to the coal it is alleged to be. For example, admixtures of splint bituminous coals in a quantity of crushed bright bituminous coal would be very difficult to ascertain by any technique but microscopy, yet this admixture might be deleterious to the operation of an industrial user of bright coal. The presence of splint coal could be detected by making preparations for microscopic study of a representative sample of the crushed coal. The greater amount of opaque matter in a thin section of splint coal is a distinctive and easily detected characteristic.

Possibly the earliest use of coal microscopy in a legal controversy was in the British courts of a century ago. In the 1850's there was lengthy litigation about whether a boghead coal of Torbane Hill, West Lothian, Scotland, was coal or a mineral and hence whether the coal or mineral laws applied to it. Many investigations, several of them microscopic, were made on the nature of the substance, with the court finally supporting the contention that it was indeed coal. The research on this question led to considerable interest in coal microscopy, even at that early date. Coal microscopy as a well developed science, however, is of much later origin — for the most part a product of this century, especially the last three decades.

Summary

As utilization of coal in this country swings more and more from simple combustion toward chemical processing, microscopy should play an important role. Microscopy will help in the selection of coal beds or parts of coal beds for special purposes of chemical utilization. It also can be expected to help in improving industrial procedures by explaining why reactions proceed as they do. Experience in science shows that the greatest advances of technology usually develop where the base of scientific information is the broadest and most comprehensive. Thus, microscopy will probably play an increasingly important part in the future of coal science.

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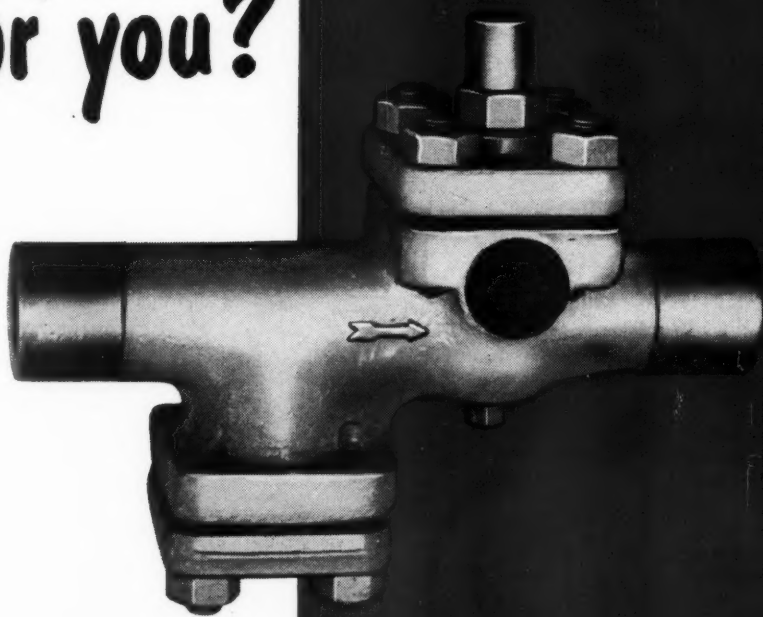
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Survey Casts Light on Wage Scales

Administrative and technical employees tend to receive similar pay for similar qualifications regardless of their industry, location, or the size of their companies according to a survey just completed by the Executive Compensation Service of the American Management Association.

The 32 companies in 16 industries covered in the study are located in rural and urban areas and vary in size from annual sales of less than \$5 million to more than \$500 million and from less than 1000 employees to more than 30,000. Despite this diversity, the average variation between the lowest and highest salaries paid for the 20 positions studied was only 54 percent. This spread is not much greater than those found in salary ranges established by individual companies for given positions. The highest rate paid for a junior engineer, for example, is only 26 percent above the lowest rate paid, while the highest-paid systems and

procedures analyst tops the lowest-paid one by 66 percent.

For the most part, administrative and technical personnel are given the same treatment as middle management in matters of salary administration and other phases of compensation practice. Policies on overtime, general salary increases, and salary administration are similar for most "exempt" employees (exempt from compulsory overtime penalty pay provisions of the Fair Labor Standards Act).

Earlier studies of nearly 600 companies showed that only 21 percent of these companies report additional pay for overtime work performed by exempt personnel, and a third of the companies which make such provisions do not extend them beyond the \$7000-a-year level. Nearly all of them place maximum limits on the amounts that will be paid.

Thirty-five percent extend general salary increases to exempt per-

sonnel. Many, however, use a "cut-off" salary level of \$10,000 a year beyond which general increases are not extended. Forty percent have formal salary administration programs for exempt personnel. Most of these include the use of organization charts, position descriptions, job evaluation procedures, and established salary ranges. An additional ten percent have established salary ranges without formal position description and evaluation methods.

The new AMA compensation survey is the first of a continuing series designed to report salary ranges and trends for specific administrative and technical jobs in business and industry. It analyzes salaries paid to 370 employees in 20 exempt categories. Most of the positions studied are primarily technical or highly specialized in nature. Typical are various professional levels in such fields as chemistry, industrial engineering, electrical or mechanical engineering, quality control, and safety. Also included are chief inspector, designer-draftsman, sales or service engineer, and systems and procedures analyst.

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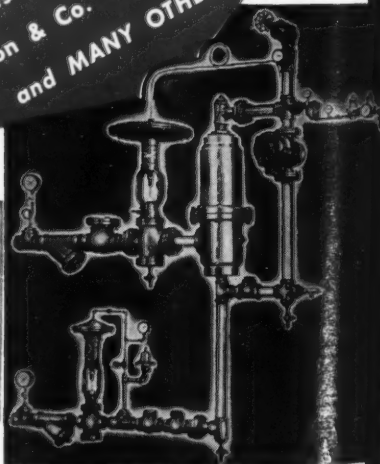
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International Developments In the Power Field

H. R. H. the Duke of Edinburgh on August 3 set the Kitimat-Kemano Aluminum project (see "Alcoa's Power Plant Goes Underground," page 39 this issue) into operation by lifting from the smelter production line the first ingot of aluminum to be poured at this important new industrial center. Thus was marked the completion of three and a half years of intensive construction work on the vast hydroelectric and aluminum project on the coast of British Columbia.

World Power Conference

Plans for the fifth world-wide World Power Conference have been announced from Rio de Janeiro, Brazil where a section convention closed August 10. The Conference will be in Vienna, Austria June 18 to 23, 1956. A study tour will follow the meetings.

During the Rio meeting Thailand was admitted to membership and Spain reinstated. ▲▲

Electrical Distribution Report "In-Plant Electrical Distribution"

Reprinted from
Industry and Power
August, 1954

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consulting engineers' calendar

| Date | Sponsor | Event | Location |
|---------------------|---|------------------------------------|--|
| Aug. 25-27 | Western Electronics Show | Convention and Exposition | Los Angeles, Calif. |
| Sept. 8-10 | American Society of Mechanical Engineers | Fall Meeting | Hotel Schroeder Milwaukee, Wisc. |
| Sept. 12-16 | American Institute of Chemical Engineers | Fall Meeting | Colorado Hotel Glenwood Springs, Colo. |
| Sept. 12-16 | Illuminating Engineering Society | National Technical Conf. | Chalfonte-Haddon Atlantic City, N. J. |
| Sept. 15-17 | Compressed Air and Gas Institute | Meeting | Skytop Lodge Skytop, Pa. |
| Sept. 15-20 | Instrument Society of America | International Instrument Exp. | Convention Hall Philadelphia, Pa. |
| Sept. 21-23 | Society for Experimental Stress Analysis | Annual Meeting | Bellevue-Stratford Philadelphia, Pa. |
| Sept. 27-29 | American Institute of Electrical Engineers | Petroleum Conference | Mayo Hotel Tulsa, Okla. |
| Sept. 28- Oct. 1 | Association of Iron and Steel Engineers | Exposition | Public Auditorium Cleveland, Ohio |
| Oct. 4-6 | National Electronics Conference | 10th Annual Conference | Hotel Sherman Chicago, Ill. |
| Oct. 5-7 | American Institute of Electrical Engineers | Middle Eastern Dist. | Abraham Lincoln Reading, Pa. |
| Oct. 6-8 | MTM Association for Standards and Research | Annual International Conference | Hotel Statler New York, N.Y. |
| Oct. 11-15 | American Institute of Electrical Engineers | Fall General Meeting | Conrad Hilton Hotel Chicago, Ill. |
| Oct. 18-22 | American Society of Civil Engineers | Convention | Hotel Statler New York, N. Y. |
| Oct. 19 | American Institute of Consulting Engineers | Annual Dinner | Hotel Statler New York, N. Y. |
| Oct. 25-27 | American Institute of Electrical Engineers | Machine Tool Conference | Hotel Statler Detroit, Mich. |
| Nov. 10-12 | Industrial Management Society | Management Clinic | Hotel Sherman Chicago, Ill. |
| Nov. 28- Dec. 3 | American Society of Mechanical Engineers | Annual Meeting | Hotel Statler New York, N. Y. |
| Nov. 29- Dec. 2 | 1st International Automation Exposition | Exposition | 242nd C. A. Armory New York, N. Y. |
| Dec. 12-15 | American Institute of Chemical Engineers | Annual Meeting | Hotel Statler New York, N. Y. |

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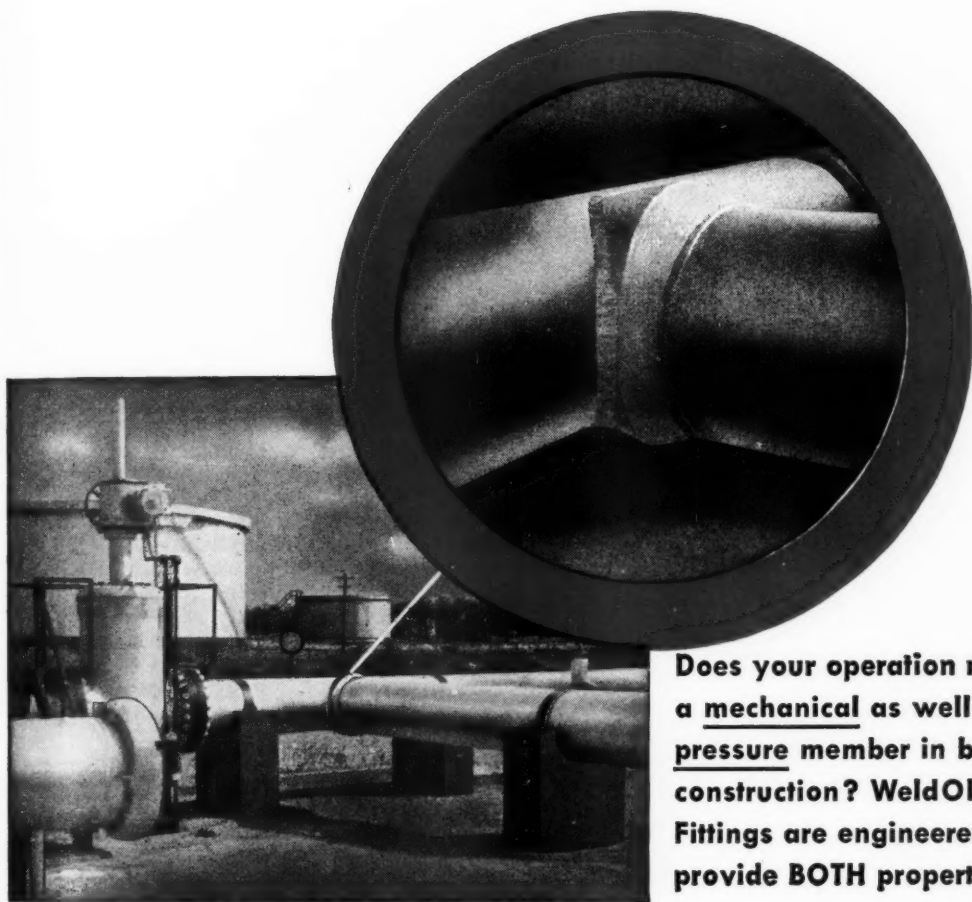
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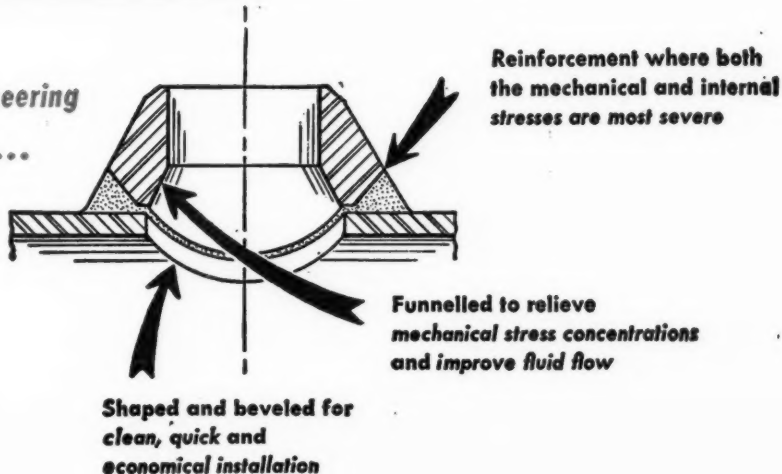
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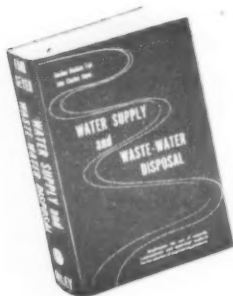
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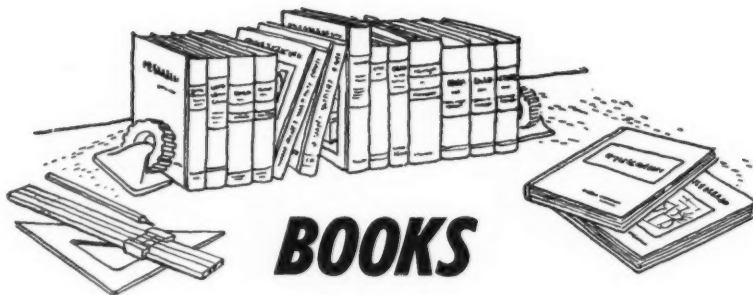
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THE STEEL SKELETON, Volume One, Elastic Behaviour & Design; by J. F. Baker; Cambridge University Press; 206 pp; \$8.50.

Reviewed by Frederick P. Wiesinger, structural design engineer, Rogers & Snitoff, Inc., Consulting Engineers, Chicago, Illinois

This volume tells the story of researches made in Great Britain to establish a more rational basis for structural steel design, giving specific recommendations. These investigations were conducted by the Steel Structures Research Committee. The reader will agree with the publisher that "this book should be in the hands of every structural engineer who does not wish to remain a technician applying rule-of-thumb methods," even though the chance of finding direct application for these recommendations in everyday American office practice is rather slim. In other words, this book is much more than a design manual; it should be required reading, the prime function of which is to illuminate the true behavior of steel structures and utter naiveté of current design practice and specifications.

The book begins with a review of building regulations. Even though the required ultimate strength and general working stresses for structural steel are quite comparable in the six countries listed, the allowable compression in columns shows an extremely wide variation. Some provide for various end conditions, some do not. There is great confusion concerning the unsupported length of the columns, and even greater, regarding the moments transmitted from the beams.

Tests made on a full scale frame and on existing buildings are described next. The connections were

made mostly with top and bottom angles, with or without web angles. The bending stresses in the columns were found to be from two to five times greater, and the beam stresses seventeen to twenty-five percent smaller than those computed on the usual assumption of simply supported beams with eccentricity of connections taken into consideration.

To achieve a more realistic design, an ingenious system was worked out. This is a modified rigid frame design taking into consideration the degree of restraint at the connections. Charts, tables, and nomographs are presented. Although these recommendations are a great improvement over the usual practice, they were doomed to failure. In our opinion, the reason for this failure was that they didn't go far enough. On the surface, the cause for rejection by the profession and industry was that they were too laborious for the designer and did not result in saving for the owner. Beams became lighter and columns heavier. This means that the structure became safer because at least the columns were not under-designed any more. But then countless structures designed by the old method stood up after all. They go into plastic stage, and redistribution of moments takes place.

This is the first of the two underlying reasons why the recommendations had to fail; they didn't take plastic behavior into consideration. The next volume, and it is awaited eagerly, promises to treat this problem. The second reason is that the recommendations used working stresses and these are based on a uniform safety factor, the same for both live and dead load. This will result in striking discrepancies; a structure designed for relatively heavy dead load will support ten

times the design live load, while one designed for relatively light dead load will collapse under twice the design live load. It is only hoped, because there is no hint to this effect, that the next volume will correct this shortcoming too.

A new set of recommendations based on plastic behavior and on a factor of safety applied with discrimination will be most welcome. Deflection and vibration will be some of the problems whose importance will reach new proportions.

ALSO AVAILABLE

OIL AND GAS ENGINE POWER COSTS—1953; The American Society of Mechanical Engineers; 52 pages; \$2.50. This is the twenty-fifth annual report of Oil and Gas Engine Power Costs, a book which has been considered an essential part of the library of every engineer who deals regularly with the operation of larger internal combustion engines. The major portion of the book is made up of tables presenting information on production costs, comparative costs from 1929 through 1951, and engine details and operating information. The tables deal with low speed stationary generating plants.

AMERICAN STANDARD REQUIREMENTS FOR TRANSFORMERS; American Standards Association; \$1.00. The Standard for transformers has been "on trial" since March 1952. Suggestions from users, manufacturers, and others who have employed the proposed Standard are included in this book. The Standards presented will enable users to buy standard designs weighing as much as 30 tons and costing up to \$45,000 or more each. Manufacturers estimate that more than \$100,000,000 in transformers of ratings covered by the Standard will be sold in the next three years.

HANDBOOK OF STANDARD TIME DATA, by Arthur A. Hadden and Victor K. Genger; The Ronald Press Company; 473 pages; \$10.00. A one volume source for all the tested, detailed standard data needed to establish machine shop time values is available for the first time. The publication presents separate tables for each common type of operation—lathes turning, milling, drilling, grinding, precision boring, broaching, boring mill operations, planing and shaping, assembly, punch press operations, arc welding, gear cutting, and power sawing.

These data were developed by an outstanding firm of management engineers (Hadden & Ortman Inc.) and are used in many plants. The tables make possible accurate predictions of the time required to perform a particular job. Using them, a consultant can establish production standards directly from blueprints.

PROCEEDINGS OF THE NATIONAL ELECTRONICS CONFERENCE, 1953, Volume IX; National Electronics Conference; 922 pages; \$5.00. This book contains all the technical papers and addresses presented at the 1953 National Electronics Conference. The 98 technical papers cover electronic research, development, and applications in audio circuits, communication, computers, electron tubes, filters, instrumentation, magnetic amplifiers, materials and components, microphonics, microwaves, network synthesis, nucleonics, servomechanisms, television, transistors, and ultrasonics.

Volumes 2 through 8 presenting the papers of earlier meetings can also be obtained at \$5.00 per copy.

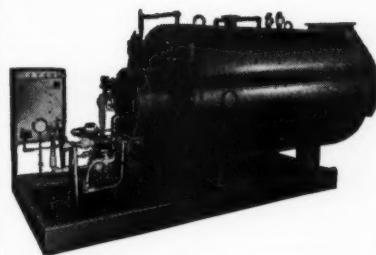
INDUSTRIAL FILMS

"READY FOR SEA," Raytheon Manufacturing Company, color and sound, 16 mm, 13 minutes. A film featuring the colorful and dramatic phases of the design, production, and testing program conducted in conjunction with "Mariners Pathfinder" radar. The movie shows how radar, designed to guide small vessels through night, fog, and storm, is made. Scenes were filmed in the M.I.T. wind tunnel, on board the Eastern Steamship Liner, SS Yarmouth, and on Raytheon's floating laboratory, Alan.

"MODERN MINING," Thor Power Tool Co., sound and color, 16 mm, 20 minutes. Filmed underground at the Colorado School of Mines properties, this motion picture features action scenes of Thor sinker leg, stopper, air column, air bar feed, and power feed drifter machines. The film is professionally narrated and has a special musical score.

"INSTALLING ARMORED CABLE," black and white, sound, 16 mm, 27½ minutes. This film sets forth the steps required for the installation of armored cable. The body of the film is devoted to a step-by-step record of a simple installation job in a house under construction, beginning with the careful plans for the entire wiring system. The ease of installation is apparent in the later sequences illustrating representative problems encountered in the average construction job.

"MECHANICAL ENGINEERING," 16 mm, color, 20 minutes. Designed for showing before high school groups interested in engineering careers, this film includes scenes of training on the Michigan State College campus and professional engineers at work in Michigan industrial plants. It tells about training, job opportunities, and the future in the field of mechanical engineering. It was produced by and at the School of Engineering at Michigan State.



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READER SERVICE SUPPLEMENT

This Supplement is provided as a service to our readers. You can secure information on products and equipment advertised in recent issues of **CONSULTING ENGINEER** by referring to the following pages of manufacturers' bulletins. Four postcards are provided for your convenience in ordering personal copies of the literature.

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Bring your Technical Reference Files up to Date

Part 2 August 1954

AIR CLEANING AND DUST COLLECTION



1—Dust Control

"Stop Dust in Power Plants," four-page folder B-1, explains benefits of liquid diffusion in power plant operation for dust control in coal handling, fly ash control, coal storage pile treatment, and slag and scale removal. Proportioning units for liquid diffusion compounds are pictured with information on selection. *Johnson March Corp.*



2—Induced Draft Fan

The induced draft bifurcator is a motor driven axial-flow fan in a divided housing. Construction details and dimensional drawings are included along with suggested methods for installation. Bulletin DB-32-53—"DeBothezat Induced Draft Bifurcators." *DeBothezat Fan Div., American Machine and Metals, Inc.*



3—Reverse Air Jet Filters

All the information you need to understand operation, design, and application of Reverse Air Jet Filters is packed into this 12-page catalog. Drawings show dust filters engineered to meet specific needs and graphs give filter performance curves for various types of dust. Self-adjusting blow rings are described in detail. *Johnson March Corp.*



4—Roof Ventilator

An accessible, easy to maintain roof ventilator is described in the 12-page bulletin "Power-Flow Roof Ventilators." These units provide controlled ventilation at all times and can be used with or without duct systems. Exhaust capacities are up to 40,900 cfm. *DeBothezat Fan Div., American Machine and Metals, Inc.*



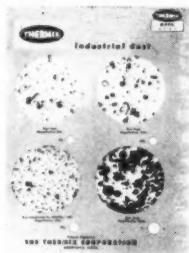
5—Industrial Dust Collector

Bulletin 1-ATC-1 gives information on Integral Two-Stage System for handling all types of industrial dust, easily, economically, and efficiently. This Industrial Collector is applicable to metal working plants and provides constant, pressure drop across the hood. Booklet includes tables of capacity requirements. *Aerotec Corp.*



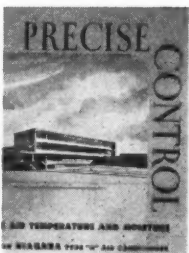
6—Exhaust Control

How catalytic exhaust systems remove fumes from exhausts of internal combustion engines is explained in this four-page folder. The new Dieseler exhaust which cuts smoke, odors, and CO content of 4-cycle diesel engines is also described. A graph compares CO content from equipment with and without system. *Oxy-Catalyst, Inc.*



7—Industrial Dusts

Twelve page booklet 3-TTC-1 gives a comprehensive background of modern dust problems and an approach to their solution. Discussed are sources of dust, determining dust size, prediction, fly-ash emission codes, types of dust, and methods of control. Diagram shows distance of dust travel from source. *The Thermix Corp.*



8—Air Conditioning

Precision control of air temperature and moisture enable you to produce your product in any climate, at any season, according to six-page bulletin 122. The Type "A" air conditioner described, for drying or moistening of air, is shown in typical installation photographs. Drawing points out operation. *Niagara Blower Co.*



9—Tubular Dust Collectors

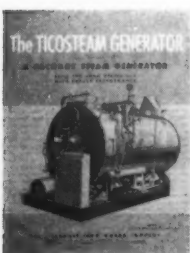
Six booklets, 3-PDC-1, 2 and 2-PDC-1 through 4, on mechanical dust collectors cover capacities and efficiencies, dimensions, construction, and the decantation method. Latter method is used on installations where reinjection of large, unburned high carbon particles is required for economical operation. *Prat-Daniel Corp.*



10—Air Pollution Control

A full-page process diagram illustrates a typical Oxycat installation in this four-page folder. Text with the flow diagram tells how the unit controls air pollution and recovers waste heat which can in turn be returned to oven, converted to steam, or used in other processes in the plant. *Oxy-Catalyst, Inc.*

POWER PLANT EQUIPMENT



11—Package Generator

Six-page foldout B-3100 describes in detail the Tico steam package steam generator, a three-pass, constant furnace pressure, forced draft, fire tube, horizontal boiler which is fitted with burners of special design permitting use of any desired type of gas or fuel oil or combination. *The Titusville Iron Works Co., Div. of Struthers Wells Corp.*



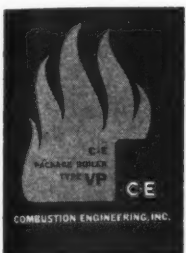
12—Wormfeed Stokers

The complete line of Canton's wormfeed stokers, for bituminous and anthracite, are pictured in 12-page bulletin 553. Two-page drawing shows a typical modern boiler room layout for automatic coal firing and control. Combustion controls, conveyors, and blowers are also described briefly. *Canton Stoker Corp.*



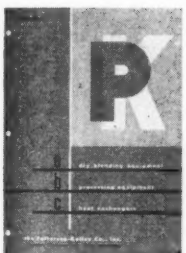
13—Steam Generators

Completely integrated steam generating plants are described with text, illustrations, and drawings in 15-page booklet SB-51-7500. Progress photographs show one of the units during assembly and testing. Cross sections are given for the entire unit, the rotary cup burner, and the steam atomizing burner. *Erie City Iron Works.*



14—Package Steam Generators

Fourteen-page bulletin 2000 will give you a better understanding of the design, development, and application of the Type VP package steam generator. Controls, feedwater regulator, furnace, gas passes, and baffles are all shown by means of drawings. Advantages of the pressurized furnaces are explained. *Combustion Engineering, Inc.*



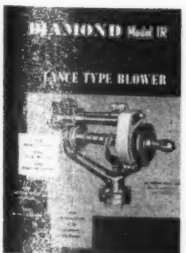
15—Heat Transfer

Various types of heat transfer equipment are among the products described in 12-page catalog 12. Also presented are various types of dry blending equipment and such process equipment as kettles, evaporators, vessels, reactors, tank suction heaters, and coils in cross sections and photographs. *The Patterson-Kelley Co., Inc.*



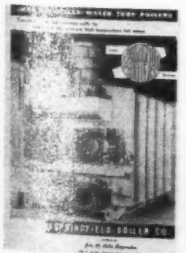
16—Heat Exchangers

Air-flow diagram in two-page data sheet 124 shows graphically operation of the Aero Heat Exchanger for water, oil, or compressed air cooling. How the unit saves cooling water, piping, pumping, and equipment costs is explained, and photographs point up ease of installation. Use in metal working is described. *Niagara Blower Co.*



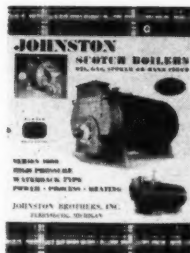
17—Soot Blowers

Four-page bulletin 1079 lists 15 advantages of the short retracting lance type soot blower. This is an electric motor operated unit with a 12 in. travel. Typical applications are illustrated and cross-sectional drawings show the unit in retracted and blowing positions. *Diamond Power Specialty Corp.*



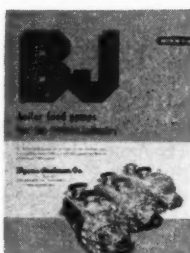
18—Package Boilers

Two-drum, bent tube package boilers for steam, and high pressure, high temperature hot water are discussed in a four-page folder. Ratings, data, and dimensions are given in table form. Cross-sectional drawings show ease of installation and typical applications. *Springfield Boiler Co., Div. of John W. Hobbs Corp.*



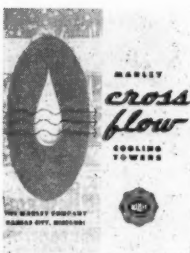
19—Scotch Boilers

Series 4000 high pressure waterback type scotch boilers for oil, gas, stoker, or hand firing are illustrated with notations on special design features in this four-page folder. Sectional drawings, specification tables, and installation photographs are included along with mounting directions and applications. *Johnston Brothers, Inc.*



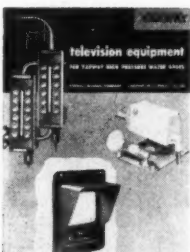
20—Boiler Feed Pumps

To meet the limitless requirements for boiler feed service, this company has developed the five standard types of boiler feed pumps described in 11-page bulletin 52-4500. The two-page cutaway drawing shows design and operation of a double case boiler feed pump. Of special interest are photos of the modern test laboratory. *Byron Jackson Co.*



21—Cooling Towers

Based on the experience of more than 25 years in designing, producing, and testing all types of mechanical draft cooling towers, this 30-page brochure presents the case for cross-flow cooling as the method that offers the greatest number of advantages. Drawings illustrate principles of operation of single, double, and twin-flow units. *Marley Co.*



22—Industrial Television

In many high pressure steam plants there is a need for televising boiler water level gages so that readings may be viewed at more convenient locations. Recognizing this need, this company offers four-page bulletin W6-1813 describing RCA's industrial TV installation for use with Yarway Flat-Glass Water Gages. *Yarnall-Waring Co.*



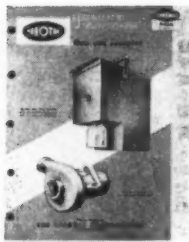
23—Steam Generators

The advantages of shop-assembled power for your plant with Type-A water tube steam generators are explained in eight-page bulletin 52-1. Line drawings show the flexibility of design possible and arrangements for various applications. Boiler engineering data is in handy table form. *The Wickes Boiler Co.*



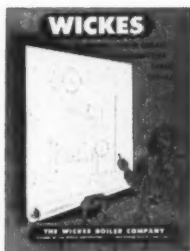
24—Packaged Boilers

Packaged automatic boilers for light oil, heavy oil, gas, or combination gas or oil firing are featured in 16-page bulletin 1219. Ratings for 15 to 500 hp units are tabulated and installations for steam process and steam and hot water service are illustrated and described. A cross-section shows components. *Orr & Sembover, Inc.*



25—Flue Gas Sampler

Bulletin 5-ATC-1 on the Flue Gas Sampler describes a device for obtaining dust samples from the stream of gas. The unit is designed to be easily portable and employs a small diameter cyclone tube as well as a bag filter. Tables, charts, and sectional drawings are included along with a list of five major advantages. *Aerotec Corp.*



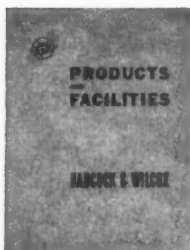
26—Water Tube Boiler

According to this eight-page publication, standardization of design has made possible the manufacture of a modern, compact, and efficient water tube boiler of two-drum design. Designs are available for oil burning or stoker feed as well as gas. Bulletin is 49-1, "Two-Drum Type S Steam Generators." *The Wickes Boiler Co.*



27—Fan Stacks

Three booklets, 1-PDC-1,2,3, on Venturtype combined stack and induced draft fans include complete descriptions, construction and design, and components. Also included are installations and applications for other than conventional boiler stacks. Diagrams illustrate six basic types available, and one conversion unit. *Pratt-Daniel Corp.*



28—Boilers and Accessories

"Products and Facilities," 69-page general catalog G-63-A shows representative examples of products manufactured and some of the numerous facilities for producing them, together with illustrations of typical installations. Cross sections, flow diagrams, cut-aways, and photographs are given for each unit. *Babcock & Wilcox Co.*



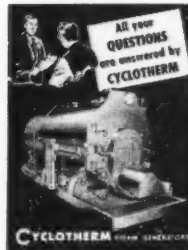
29—Condensers

The integral reverse-flow steam condenser provides the most practical method for cleaning the tube sheet and eliminates need for mechanical water straining apparatus according to eight-page booklet 410-1-5M. Typical arrangements of devices to accomplish the reverse-flow are pictured and explained. *C. H. Wheeler Mfg. Co.*



30—Oil Reclaimer

Subject of four-page folder R-247 is a self-contained, compact oil reclaimer for keeping industrial oils free from contaminants. In addition to describing how the process works, the bulletin suggests applications, gives specifications, advantages, and lists results to be expected with the use of the unit. *The Hilliard Corp.*



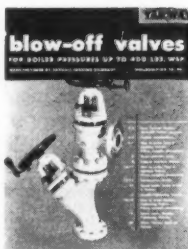
31—Cyclonic Combustion

Principles of Cyclonic Combustion are explained in four-page folder, "All Your Questions Are Answered by Cyclotherm." Drawings show how air is introduced into the combustion chamber at extremely high speeds in a revolving spiral vortex, radiating heat to the fire tube. *Cyclotherm Division of United States Radiator Corp.*



32—Flexible Gear Couplings

Advantages and typical applications of flexible gear couplings are pictured and described in 16-page catalog C-4, "The Revolutionary New Sier-Bath Flexible Gear Couplings." Couplings are available in standard, vertical, mill-motor, floating shaft and spacer type, plus many special types. *Sier-Bath Gear & Pump Co., Inc.*



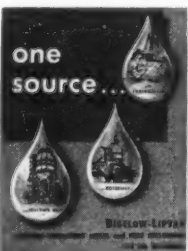
33—Blow-Off Valves

Bulletin B-426, 19 pages, contains full details of Yarway Seatless Blow-Off Valves and Yarway Double-Tightening Blow-Off Valves for boiler pressures up to 400 lb wsp. Indexed for handy reference, the catalog gives installation recommendations, construction details, and prices. Properties are given in tables. *Yarnall-Waring Co.*



34—Flue Dampers

Four booklets, 1-HEA-1, 2, 3, 4, on curtain type dampers for flue gas control explain what the damper is and does, construction, dimensions, installations, and give case histories. Description and applications are treated completely. Booklet shows drawings and photographs of a variety of damper types. *Heacon, Inc.*



35—Castable Refractory

Two-page spread in booklet 35 shows sectional drawings of a fluid catalytic regenerator and auxiliary catalytic equipment lined with castable refractory. The bulletin also describes the service whereby this company provides engineering, materials, and erection service for vessel lining or heat enclosure jobs. *Bigelow-Liptak Corp.*



36—Tubes and Plates

Technical and practical knowledge accumulated during more than a century of experience in the manufacture of brass and copper products is available to you in 43-page bulletin "Aconda Tubes and Plates for Condensers and Heat Exchangers." One section is devoted to the problem of condenser tube corrosion. *The American Brass Co.*



37—Heaters

Horizontal and vertical heaters in steel, copper lined, copper-silicon, cement lined, clad and galvanized construction, as well as the low-flow design are each cataloged as to weights, dimensions, construction details, and capacities, with conversion tables, in 48-page catalog 18. Piping diagrams are given. *The Patterson-Kelley Co., Inc.*



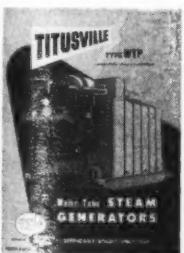
38—Deaerating

Flash type deaerating feedwater heating systems completely assembled as a packaged unit with interconnecting piping and assembly supports are described in bulletin 120 "Heat Transfer Equipment for Power Plants." This eight-page bulletin gives layered diagrams and equipment specifications. *Whitlock Mfg. Co.*



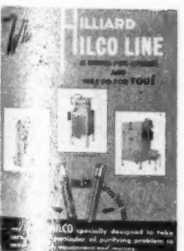
39—Engines

A complete folder containing 60 pages describes diesel and dual-fuel engines (including sewage gas engines) ranging from 9 to 1765 bhp. Engines are available with speeds to suit a wide range of fixed or skid-mounted engine applications. Cross-sections, graphs, and charts give valuable engineering data. *The National Supply Co.*



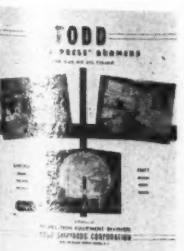
40—Shop-Assembled Boilers

Sectional side elevation and front elevation drawings show in detail the design of type WTP completely shop-assembled water tube steam generators in six-page bulletin B-3275. Adaptations possible, design, operating facts, and specifications are discussed. *The Titusville Iron Works Co., Div. of Struthers Wells Corp.*



41—Oil Filters

Oil reclaimers, air line oil purifiers, and Hyflow oil filters of various types and sizes are shown in actual installation photographs in eight-page bulletin 96. Economy of operation and the savings in operating and maintenance costs are explained for each of the various types as applied to specific uses in various industries. *The Hilliard Corp.*



42—Burners

The Roto-Press burner described in seven-page booklet 9101 is designed to meet the demand for maximum steam, automatic firing, minimum floor space, and elimination of high stacks. How to convert your standard rotary burner to a Roto-Press is explained by means of text and pictures. *Combustion Equipment Div., Todd Shipyards Corp.*



43—Stationary Diesels

Bulletin 5202, eight pages, describes Model 65 Superior stationary diesel engines. Engine is available at ratings from 580 to 1765 hp at varying supercharged pressures. Each component of the engine is discussed. Specifications and general data are included with dimensional drawings and graphs. *The National Supply Co.*



44—Safety Devices

Water columns, gages, valves, and other boiler safety devices are described in catalog 500, "Boiler Water Columns and Gage Equipment," now available to consulting engineers. Many new designs are completely described with photographs, cross sections, and mechanical drawings. *The Reliance Gauge Column Co.*



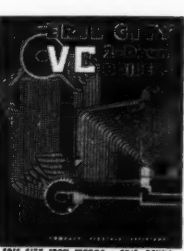
45—Gages and Columns

How the Bi-Color water gage operates to show actual water level without transmission by mechanical, electrical, or hydrostatic means is explained in 23-page bulletin 1051. The many types of gages and their installation are pictured. High-low water alarms, soot blowers, and wired television are shown. *Diamond Power Specialty Corp.*



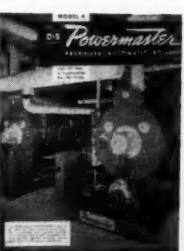
46—Instantaneous Heaters

Answers to your hot water problems are given in booklet "Methods and Means." Operation and advantages of the instantaneous water heater as compared to the indirect method heater are discussed and illustrated. Units discussed are pre-engineered, and factory assembled for each particular need. *Pick Manufacturing Co.*



47—Two-Drum Boilers

How to conserve boiler room space by specifying VC 2-drum boilers is explained in 15-page bulletin 5M. Drawings and tables are given for units for underfed stoker firing and for oil or gas firing. Related equipment is also described. Compactness, simplicity of installation, and low maintenance are stressed. *Erie City Iron Works.*



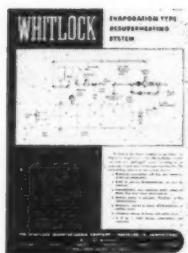
48—Simplified Boilers

The new line of simplified Powermaster packaged automatic boilers in sizes 15 through 100 hp, light oil or gas, are discussed in eight-page bulletin 1230. Details of design and construction, a cut-away view, and sample specifications are given for various sizes and types included in the line. *Orr & Semblower, Inc.*



49—Water Heaters

Steam injection water heaters with the pressurizer piston for safe, quiet, automatic control are described in four-page pamphlet WH12A. How the unit saves space, time, fuel, installation, and maintenance costs is explained. Specifications for seven standard sizes—both direct and accumulator application—are in tables. *Pick Manufacturing Co.*



50—Desuperheating

Bulletin 150, "Evaporation Type Desuperheating System" is a two-page catalog insert which gives a piping diagram and a rating and characteristics table for evaporation type desuperheaters. This equipment is offered as a packaged unit including all automatic controls. Booklet includes tables. *The Whitlock Mfg. Co.*

BUILDING MATERIALS AND EQUIPMENT



51—Building Panels

"Steel and Aluminum Building Panels," 42-page catalog 23M gives complete descriptions of Fenestra panels for floors, walls, roofs, and ceilings, including the new Fluted Insulated Wall section, Type F. Cross sections illustrate how panels are attached to supports. Engineering data are included in tables. *Detroit Steel Products Co.*



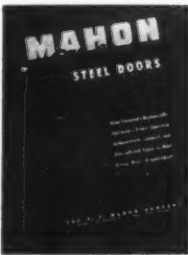
56—Wall Construction

It's faster to hang a wall than to pile it up, according to eight-page foldout Q-26-53. Described by means of photographs and drawings are wall-building units made of flat and fluted (or two flat) metal sections enclosing an inch and a half of insulation. Bulletin V-13 describes round type ventilators. *H. H. Robertson Co.*



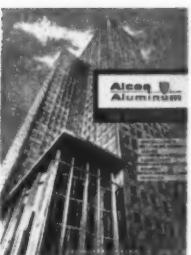
52—Concrete Wall Panels

Insulated precast concrete wall panels and rigid steel framing combined in custom "panel bilt" buildings are shown in four-page pamphlet 7285. Panel and structural details are shown for every industrial and commercial purpose described. How this type of construction saves time and money is explained. *Marietta Concrete Corp.*



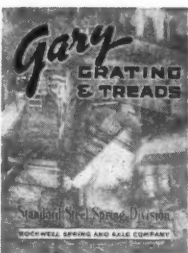
57—Rolling Steel Doors

Rolling steel doors, grilles, and shutters to meet every requirement of industrial or commercial use are carefully and completely described in 13-page catalog G-54. Drawings, tables of clearance dimensions, standard and special applications, and complete specifications make this a good reference bulletin. *The R. C. Mahon Co.*



53—Aluminum Architecture

"Alcoa Aluminum in Architecture," 31-page booklet AD-262, is a comprehensive survey of applications of aluminum. Valuable tables include: characteristics of typical wrought and cast aluminum alloys; selection of alloys; finishes; and resistance to atmospheric weathering. *Aluminum Company of America.*



58—Grating and Treads

Gary grating and treads tailor-made to suit your individual requirements are illustrated in a 21-page brochure. Two-page spread includes tables of safe loads, specifications, and other engineering data. Photographs also show many typical applications of the decking. *Standard Steel Spring Div. of Rockwell Spring and Axle Co.*



54—Roof Construction

"An Analysis of Six Popular Roof Constructions," ten pages, shows how the various roof types stack up against each other from the standpoint of steel required, gutters, downspouts and flashing, covering material, sash, ventilation, and daylighting. Booklet R-17 describes Galbestos roofing and siding. *H. H. Robertson Co.*



59—Asbestos Cement

Specifications, detail drawings, and total load tables for "poured-in-place" gypsum roof deck are included in bulletin 589 in handy loose-leaf form, ready to slip into a notebook. Sample problems and solutions demonstrate use of the load chart. Included is Gold Bond Insulation and Asbestos Cement form boards. *National Gypsum Co.*



55—Gypsum Roof Deck

Corrugated asbestos cement roofing and siding is discussed in detail in 15-page data booklet 2032 including specifications, sheet applications, fasteners, closure strips, ridge roll, and trim. Section drawings show application of this company's product, known as Asbestos, to wood and steel frames, and gutters. *National Gypsum Co.*



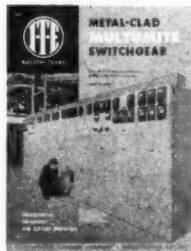
60—Stainless Walls

"Walls and Roofs for Industrial Buildings," 16 pages, gives you complete details on one of today's most promising developments in industrial construction. It describes the use of USS 12 (Type 410) and USS 17 (Type 430) stainless steels in roofs and exterior walls of all types of industrial structures. *United States Steel Corp.*

ELECTRICAL EQUIPMENT

61—Electrical Connections

Cadweld process described in 76-page electrical connection catalog is a method of welding copper to copper or steel without an outside source of heat. Equipment to form many types of electrical connections is described. Types of connections include cable, ground rod, horizontal and vertical surface, rail bonds, and studs. *Erico Products, Inc.*

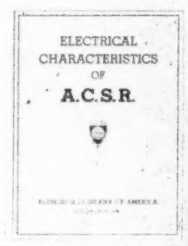


66—High Voltage Switchgear

Bulletin 7004B is a 24-page guide to I-T-E high voltage switchgear. Illustrated with diagrams and photographs, it contains separate sections of detailed information on features, switchgear components, applications, specifications, and construction data. Booklet also deals with extra services available. *I-T-E Circuit Breaker Co.*

62—Air-Cooled Transformers

All-purpose, air-cooled distribution transformers for indoor and outdoor service, described in four-page folder 49-ACO are said to be ideal for most applications formerly limited to liquid filled types. Advantages of Class B and C insulation, easy maintenance, and low cost are pointed out. *Marcus Transformer Co., Inc.*



67—Steel Cable

Aluminum cable, steel reinforced is thoroughly described in an informative 24-page bulletin made up primarily of engineering data sheets giving such information as physical characteristics, electrical resistance, inductants, and reactants. A valuable chart giving temperature rise curves of ACSR is included. *Aluminum Co. of America.*

63—Insulated Wiring

Four page folder, "20 Questions and 20 Answers on Safety Mineral Insulated Wiring" describes and illustrates characteristics and advantages of this wiring system. Table of types, sizes, weights, and lengths is included for one, two, three, four, and seven conductor. Typical uses and installations are pictured. *General Cable Corp.*

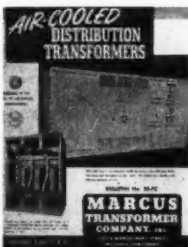


68—Motor Control Centers

How centralized grouping of motor controls for a plant or an entire factory simplifies operating procedure and inspection and conserves space is told in 15-page bulletin MS-6000. Engineering and layout data is given for three types of wiring. Suggested specifications are furnished for typical control center installations. *Federal Pacific Electric Co.*

64—Motor Starters

Combination motor starters for across-the-line starting, and reduced voltage combination starters for special applications are illustrated and described in eight-page bulletin 514 & 515. A general description, tables of dimensions and weights, and drawings are given for each type and for each application. *Federal Pacific Electric Co.*



69—Transformers

Distribution transformers are the subject of four-page folder 50-FC. Brief descriptions are presented for various types of air-cooled units from 25 to 1000 kva with various primary and secondary voltages. Standard lighting transformers also are listed. Information is available on dry types to 2000 kva. *Marcus Transformer Co., Inc.*

65—Low Voltage Switchgear

Bulletin 6004A is a 24-page guide to I-T-E low voltage switchgear. Illustrated with diagrams and photographs, booklet is full of information on features, switchgear components, applications, specifications, and construction data. It also describes the extra services which are available to users of switchgear. *I-T-E Circuit Breaker Co.*



70—Cathodic Protection

Cadweld connections for cathodic protection are described in four-page folder 549-2. Included are specification tables, drawings, and directions for ordering and installation of formed terminal connections and anode lead connections. How copper is welded to either copper or steel without heat is explained. *Erico Products, Inc.*

INSTRUMENTS AND CONTROLS

71—Flow Meters

A choice of three mercury-less transmitters—two for measurement of differential pressure and one for measurement of liquid level in an inclosed vessel—are described in the bulletin "Electronic Flow Meter," four pages. A description is also given of indicators, recorders, cases, and charts available. *Hays Corp.*



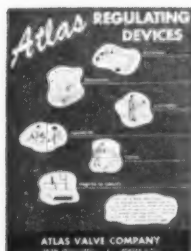
72—Automatic Controls

An enormous volume of valuable material, well illustrated, is to be found in the large, 64-page catalog No. 700-B, "Mercoid Automatic Controls for Domestic and Industrial Applications." All types of controls manufactured by this company are described in detail so that the right specifications can be written to fit the job. *Mercoid Corp.*



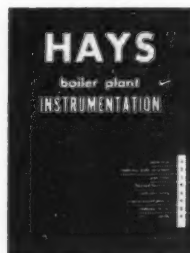
73—Heating Controls

Automatic heating controls equipped with sealed mercury contact switches for warm air furnaces, hot water heating systems, and steam heating, are described in four-page folder 281/Me. Units include thermostats, transformer-relays, primary controls, and limit and operating controls of various sizes and ranges. *The Mercoid Corp.*



76—Liquid Level Control

In four-page folder "Regulating Devices" you will find illustrated and described a representative few of the many thousands of controls made by this company for heating, power generating, and industrial process applications. Services available for designing and producing special regulators are explained. *Atlas Valve Co.*



75—Combustion Controls

"Boiler Plant Instrumentation," 23-pages, not only describes the line of boiler plant products but also the services available through the company, and case histories to show how particular plants solved specific problems. Line drawings illustrate combustion controls for both gas fired and oil fired boilers. *The Hays Corp.*



76—Liquid Level Control

Representative Autocon products for the automatic measuring and control of liquid level conditions in institutional, municipal, industrial, and commercial water distribution and processing systems are fully described in this catalog. How these products fit into the Plan-Pak custom engineered control system is explained. *Automatic Control Co.*

MATERIAL HANDLING AND STORAGE



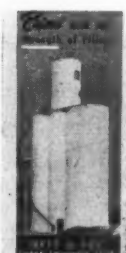
77—Vibrating Conveyors

Mechanical vibrating conveyors for large, medium, and light tonages, are described in 23-page catalog 859. Photographs and drawings explain operation and applications of standard and special types of conveyors. The oil immersed drive and the drive motor used as standard equipment are described in detail. *The Jeffrey Mfg. Co.*



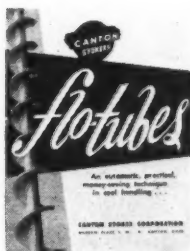
78—Storage Systems

"Modern Industrial Storage Systems," 12-page brochure 4393, discusses the subject of storage for raw ingredients, semi-processed, or finished material. The flexibility and adaptability of concrete silos is discussed. Descriptions of component parts and construction are supplemented with line drawings. *The Marietta Concrete Corp.*



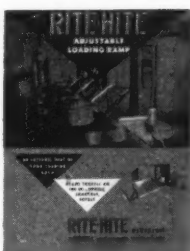
79—Storage Bins

If you specify vertical storage construction for handling flowable bulk materials, this ten-page foldout will help you visualize how this company's Super-Concrete Stave Storage Bins might meet your requirements. The booklet contains photographs of typical installations, lists uses, and explains construction. *The Neff & Fry Co.*



80—Screw Conveyors

Flo-Tube conveyors for automatic handling of coal are explained by means of flow-diagrams, installation photographs, and text, in this four-page folder. Ability of the flow-tubes to handle materials from fine mesh size to solids in size of pellets, flakes, and chips is also discussed along with auxiliary equipment. *Canton Stoker Corp.*



81—Adjustable Loading Ramps

How Rite-Hite adjustable loading ramp keeps traffic on the go—swiftly, smoothly, and safely—is graphically presented in seven-page bulletin 953. Drawings show the balanced design that makes it possible for one man to raise or lower the ramp. The ramp and dock unit for non-permanent installations is explained. *Loomis Machine Co.*



82—Conveyor Machinery

A full 42 pages of engineering application data and maintenance information is to be found in "Belt Conveyor Idlers." A valuable addition to the literature dealing with conveyor belts for materials handling, the booklet contains cross-sections, graphs, charts, and drawings of the various units made by this company. *Chain Belt Co.*

METALS AND MISCELLANEOUS MATERIALS



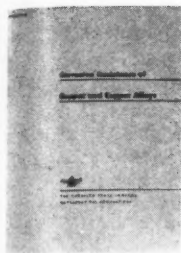
83—Thermoplastics

"Buyers Guide," 15 pages, lists services, molded and fabricated materials, and products made of Kel-F thermoplastics. Also available are: 'Properties' (bulletin 1-3-53); 'Molding Techniques' (3-10-50); 'Dispersions' (4-10-50); 'Properties of Kel-F Oils, Greases, and Waxes' (5-1-52). *Chemical Mfg. Div., M. W. Kellogg Co.*



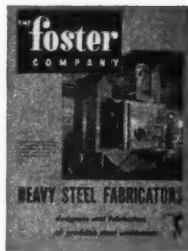
84—Stainless Steel

"An Introduction to USS Stainless Steel," 81-page brochure, contains general information on characteristics, fabrication, and application of stainless steels. Examples and illustrations of its use in many industries are given along with tables of typical properties of the various types and corrosion data. *United States Steel Corp.*



85—Copper and its Alloys

"Corrosion Resistance of Copper and Copper Alloys," 27-page booklet B-36, has been designed to assist the materials engineer in selecting the Anaconda copper alloy best suited for a specific use. Corrosion theory, types of corrosion, and general resistance are discussed. Charts show resistance of American Brass Co.



86—Steel Weldments

New close-tolerance machinery illustrated in this four-page folder makes it possible for this company to produce single components or complete assemblies to specification. Examples of equipment designed and engineered by this company are given along with cast parts that can be replaced by fabricated steel weldments. The Foster Co.

—PIPING, VALVES, AND SPECIALTIES—



87—90° Branch Welding Fittings

"Bonny WeldOlets," 32-page catalog describes and pictures weldolets and thredolets for every piping service. It is indexed for handy reference into sections on typical installations, instructions for installing, code data, and other engineering information. Sample problems are worked out by means of graphs. Bonney Forge and Tool Works.



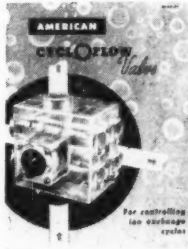
Motor Pulleys

Complete redesign of the standard line of Vari-Speed motor pulleys is described in 28-page catalog V-545. Lubrication controls available, instructions, on how to select the proper unit for specific uses, complete rating tables, and dimensional diagrams are included. The Vari-Speed Jr. is also covered. Reeves Pulley Co.



88—Process Gages and Valves

Condensed catalog 236, eight-pages, covers a complete line of process gages and valves for observation of liquids and levels. Standard and optional construction features and dimensional data are furnished in table form. Numerous optional features are described and illustrated with roughing drawings and cutaways. Jerguson Gage & Valve Co.



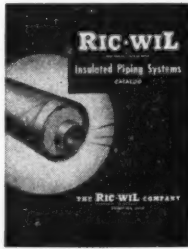
93—Flow Control Valve

Two models of the Cycloflow Valve developed for use with all ion exchange processes are described in four-page folder 600—cast iron for use with hot or cold process zeolite softeners, chloride dealkalizers, and filters; and plastic valve for corrosive service. Operation, design, and construction, are all discussed. American Water Softener Co.,



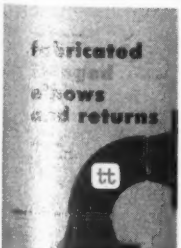
89—Rubber-Lined Pipe

Nine-page handbook presents basic principle of construction, design features, methods of installation, plus parts and tools needed to utilize the Gaco rubber-lined pipe system. It compares cost of Gaco and flanged pipe installations for replacement, repair, installation, and renovation of existing installations. Gates Engineering Co.



94—Insulated Piping

The many advantages of this company's insulated piping is told by means of text, installation photographs, and drawings. Features that make the piping efficient and easier to install are explained for underground and overhead pipe distribution systems. Maximum conduit capacities are listed in tables. The Ric-wil Co.



90—Elbows and Returns

"Fabricated Flanged Elbows and Returns" are described in detail in this 10-page bulletin. Dimensional data is presented in tabular form for welded neck flanged fittings, slip-on flanged fittings, socket type welding flanges, and fabricated flanged elbows. Simple valuable engineering information. Tube Turns.



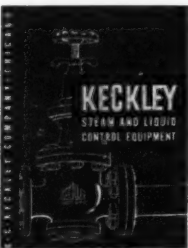
95—Snow Melting Systems

Growth of snow melting systems since the first recorded installation in 1925 is discussed in "Wrought Iron Pipe for Snow Melting Systems." Piping layouts cover a variety of installations. Text includes information on design, properties, anti-freeze, paving design and fill, fabrication and installation, operating features, and controls. A. M. Byers Co.



91—Corrosive Service Valve

Bulletin V-53, 36 pages, presents information, mostly in table form, on the Saunders patent valve for corrosive and hard to handle fluids. Cross-sections and photographs illustrate operation and uses. A list of suggested services will help you decide at a glance if this is the type for your particular application. Hills-McCanna Co.



96—Valves and Regulators

Specifications and operational data for steam, gas, air, oil, and water regulating equipment are presented in 60-page catalog 54. Illustrations and descriptions are included for pressure, temperature, and combination regulators, diaphragm, float, motor, solenoid, pop, and relief valves as well as strainers and water gages. O. C. Keckley Co.



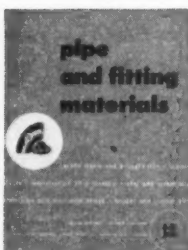
97—Spiral-Wound Gasket

Twenty-eight page general catalog tells about the development of the original spiral-wound gasket and its present application in aviation, atomic research, process industries, power plants, and ships of the Navy and Merchant Marine. It lists various metals and fillers used in the manufacture. *Flexitallic Gasket Co.*



98—Pipeline Service Connections

Boltless tapping sleeves for pipeline service connections — for cast iron or cement-asbestos pipe — are designed to outlast the pipe on which they are installed, according to this four-page folder. Dimensional and excavation drawings are included along with information on pressure tests and installation. *Corey Manufacturing Co.*



99—Pipe and Fittings

The eight-page bulletin "Pipe and Fitting Materials" contains a wealth of engineering data essential to the accurate specifications of various types of piping. It includes data on carbon, steels, and wrought iron, stainless steels, intermediate alloy steels, nickel and nickel alloys, aluminum and alloys, and copper and alloys. *Tube Turns.*



100—Instrument Piping Valves

Four-page data unit 234 contains illustrations and drawings showing how this company's valves combine unions, nipples, reducers, elbows, tees, valves, and drain valves into one space-saving unit. Application information, specifications, and features are included on valves for instrument piping and general use. *Jerguson Gage & Valve Company.*



101—Piping Data

"Piping for Permanence," 32-page bulletin contains helpful technical data based on an analysis of thousands of piping systems. Sections are devoted to a review of piping material properties, descriptions of individual services in building-piping systems, and recommendations to reduce rate and severity of corrosion. *A. M. Byers Co.*



102—Neoprene Coatings

How to solve corrosion problems with Gaco Neoprene lining is explained in four-page folder N-1. Convenient recommendation chart gives suggested applications, surface preparation, primer, accelerator, and thinner, curing directions, and coverage data for Neoprene Liquid Lining, Sheet Stock, and Skid Proof. *Gates Engineering Co.*

PUMPS



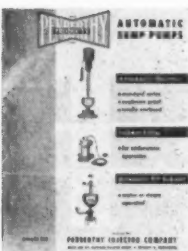
103—Rotary Pumps

Design and construction of these pumps are shown in cross-section. Features that reduce maintenance costs are explained and a phantom view shows the liner replacement. Charts compare sustained capacity and relief valve efficiency of this pump and conventional rotary pumps. Indoor and out-door uses are shown. *Blackmer Pump Co.*



106—Proportioning Pump

An explanation of operation and advantages of reciprocating mechanical drive metering and proportioning pumps, Type "U," is given in 20-page brochure UP-52R. Service recommendations for handling over 300 substances is presented along with technical data on how to select the proper unit. *Hills-McCanna Co.*



104—Sump Pumps

Automatic sump pumps, standard series, explosion-proof, totally enclosed, and submersible type are described in four-page folder 5382. Selection information includes tables of capacities, water consumption, and dimensions. Drawings are shown for sump pumps and pit drainers. *Penberthy Injector Co., Div. of Buffalo-Eclipse Corp.*



107—Screw Pump

Screw pumps for non-lubricating fluids and semi-fluids are featured in six-page folder SE-5. A large cutaway view shows construction features. Applications, advantages, and specifications are listed. Company also makes Gearex and Hydrex pumps for lower pressures. *Sier-Bath Gear and Pump Co., Inc.*



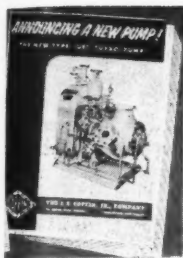
105—Vertical Pumps

"Vertical Pumps for Volatile Fluids," six-page foldout 1026, will be a welcome addition to your pump library. Well illustrated with cross-section drawings, it describes design advantages of this company's pumps for handling gasoline, diesel fuel, crude oil, L-P gases, ammonia, and other volatile liquids. *Johnston Pump Co.*



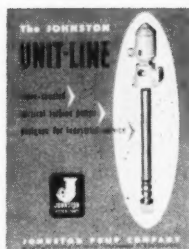
108—General Purpose Pumps

How to determine total head against which pump must operate is only one of the valuable sections in 12-page bulletin 353-1000 on the Bilton pump, a general purpose pump suitable for all classes of medium and low head service. Included are figures on pipe friction, correction charts for elevation and temperature. *Byron Jackson Co.*



109—Turbo Pump

Each component of the type DE turbo pump is pictured and its design advantages explained in a six-page folder. The lubrication system is also described in detail. Typical uses are listed. Accessibility for repairs, parts and service, ratings, and what data to give for an estimate are included. *The J. S. Coffin, Jr., Co.*



110—Vertical Turbine Pumps

A line of pumps that not only offers the inherent advantages of the engineered vertical turbine pump, but also provides economy of a packaged line from which a unit can be selected to meet existing conditions is described in four-page folder 1027. Construction detail is shown in drawings and photographs. *Johnston Pump Co.*

PROCESS EQUIPMENT



111—Combination Refining

How combination processing can slash more than 20 percent from investment costs in building today's new oil refineries is revealed in Kellogram No. 1 (1954). A detailed analysis of these savings is presented along with economic summaries comparing combination and sequence-type refineries. *Refinery Process Div. M. W. Kellogg Co.*



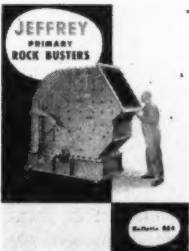
114—Dry Ice Converters

For industries which require a supply of CO₂ gas, this four-page folder describes a dry ice converter system said to incorporate several time-saving and economical features. Installation, either vertical or horizontal, is pictured. Advantages of a converter over gas cylinders are pointed out. *Dry Ice Converter Corp.*



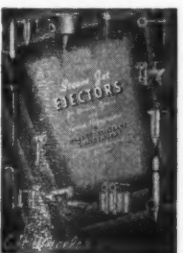
112—Asphalt Heater

Steam jet ejectors for vacuum service and refrigeration, and direct contact condensers, barometric and low level jet types are fully described in 35-page booklet 1462. Engineering data, graphs, flow diagrams, and cross-sections are given for each type. Pressure, temperature, and volume conversion tables are included. *C. H. Wheeler Mfg. Co.*



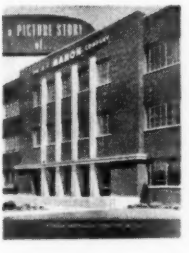
115—Rock Busters

Primary rock busters for reducing hard friable materials are shown in typical application photos and by means of dimension drawing in eight-page bulletin 854. Tables give such valuable data as specifications, capacities on average medium hard limestone, and results to be expected. Accessibility is stressed. *The Jeffry Mfg. Co.*



113—Steam Jet Ejectors

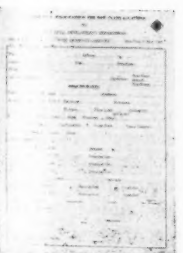
"Todd Thermo Convective Asphalt Heater," four-page folder describes details of combustion chamber, tubular heat exchanger, and related auxiliaries. It shows how this automatic, low maintenance unit is especially designed to heat asphalt economically. *Combustion Equipment Div. of Todd Shipyards Corp.*



116—Production Facilities

"A Picture Story of the R. C. Mahon Company," 46-page brochure, portrays the company's extensive metal fabricating and production facilities, its products and services, and its capacity to serve industry. Activities, products, and production methods of the eight divisions are treated separately. *The R. C. Mahon Co.*

PLANT SITE SELECTION



117—Sites

This specification card for information on new plant locations in the area served by this railroad will enable you to state briefly your client's requirements for expansion. When filled out and returned experts in the field will suggest sites to fit those needs. A map of the United States shows the railroad and its connections. *Erie Railroad.*



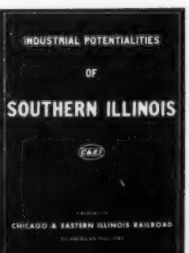
119—State Resources

"Along the Line by Nick Plate," 73-page handbook presents a composite picture of territory along the Nickel Plate line in Ohio for those needing pertinent information and statistics. Agriculture, industry, natural resources, and power are all covered. Similar booklets are available for Ill., Ind., N.Y., Pa. *Ind. Development Dept. Nickel Plate Railroad.*



118—City Resources

"Along the Line" gives specific information about one city, Findlay, Ohio,—agricultural, mineral, and water resources, manufactured products, labor, transportation, and power. Similar bulletins are available for all cities served by Nickel Plate in Illinois, Indiana, New York, Pennsylvania, and Ohio. *Nickel Plate, Ind. Development Dept.*



Southern Illinois Sites

"Industrial Potentialities of Southern Illinois," 318 pages, reports on the resources, natural and man-made, of this area. Its scope is limited entirely to factors basic to determination of new industrial location. Also available is "Industrial Potentialities of Evansville, Indiana," 87 pages. *Chicago & Eastern Illinois Railroad.*



121—Transits

Engineer's transits incorporating the patented ball-bearing, dust-proof center and ball-bearing telescope axis are described in this seven-page catalog. A full-page cross-sectional diagram illustrates component parts. Optional additions and modifications are listed along with other surveying instruments. *Brunson Instrument Co.*



122—Whiteprint Process

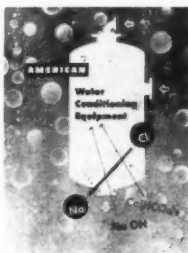
The copyflex (whiteprint) process for making copies of practically anything written, typed, or printed on a wide range of sensitized materials (paper, cloth, and film) is explained in seven-page bulletin A-2008B. Sensitized materials available are listed along with the uses for the different types and colors. *Charles Bruning Co., Inc.*

WATER TREATMENT AND WASTE DISPOSAL



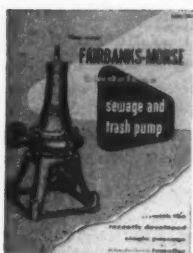
123—Atomizing Deaerators

Requirements and principles of deaeration by atomization are described in bulletin 4635. Sectioned drawing in color shows water and steam flow during operation of Atomizing Deaerating Heater. Other photographs show the variety of combinations in heaters and storage tanks available and application for marine uses. *Cochrane Corp.*



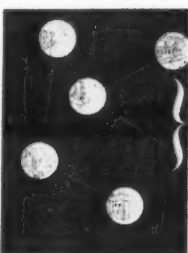
128—Water Conditioning Equipment

Application, function, operation, and design of various types of water conditioning equipment are included in six-page bulletin 200. Simplified drawings are included for spray atomizer and jet tray deaerators, hot process softeners, reactors, dealkalizers, demineralizers, continuous blow down, and many others. *American Water Softener Co., Inc.*



124—Sewage Pumps

Bladeless sewage and trash pumps with single passage bladeless impeller are discussed in 15-page bulletin 5400K-1. Construction details of horizontal and vertical shaft types are shown in large cross-sectional drawings. Principle dimensions in table form, and charts and tables make this handy reference material. *Fairbanks-Morse & Co.*



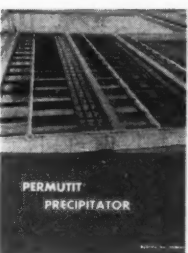
129—Water and Steam Cycles

"Industrial Water Treatment and Engineering Service," tells of the five basic lines of defense to guard against difficulties in water and steam cycles. A two-page diagram shows a water and steam cycle power plant layout and indicates the usual tests required on samples taken at designated points. *Dearborn Chemical Co.*



125—Controls

Controls for waste treatment equipment are pictured and described in 9-page foldout. Manually, semi-automatically, and fully automatically controlled chlorinators for industrial waste and domestic sewage treatment are included. Flow diagrams show how each type of control operates. *Wallace & Tiernan, Inc.*



130—Precipitator

Well illustrated 20-page bulletin 2204B describes the many applications, principles of operation, design features, advantages, recommendations, flow diagrams, and specifications of this company's Precipitator in its three basic designs. A cross section of the unit shows how chemicals are mixed with influent. *The Permutit Co.*



126—Water Conditioning

This practical 120-page data book supersedes the 1952 edition. Brought up-to-date and completely revised, it presents a compilation of 78 tables, all valuable to the engineer. Subjects covered include hydraulics, impurities in water, chemical conversions, saturated steam, and boiler feedwater makeup requirements. *The Permutit Co.*



131—Reactor Selection

Along with a general discussion of water clarification by the solids contact principle, 24-page bulletin 5001-A covers various types of reactors and outlines factors to be considered in reactor selection. Discussion of paper fibre recovery and auxiliary equipment, chemical feeds, and proportioning pumps rounds out booklet. *Cochrane Corp.*



127—Visual Vacuum Chlorinator

In the seven-page bulletin TA-1026-C a simplified flow-diagram shows the major elements and details of operation of the Visible Vacuum Chlorinators. Function and inter relationship of the various major elements in operation are explained in text and pictures for manual and automatic proportional flow control. *Wallace & Tiernan, Inc.*



132—Water Conditioning

"Some Belco Products in Pictures," six-page booklet, gives some idea of this company's scope and facilities. Automatic panel boards built and "dry run" tested by the company, various types of water softeners, preheaters, deaerators, and parts during fabrication are pictured. *Belco Industrial Equipment Div., Inc., Bogue Electric Mfg. Co.*